Dissertation on

"COMPARISON OF ACCURACY OF DIAGNOSTIC MODALITIES WITH OPERATIVE FINDINGS AND FACTORS PREDICTING PROGNOSIS IN PATIENTS WITH BLUNT ABDOMINAL TRAUMA."

BY

DR. M.KARTHIKEYAN

DISSERTATION SUBMITTED FOR THE DEGREE OF

MASTER OF SURGERY

BRANCH-1 (GENERAL SURGERY) AT

MADRAS MEDICAL COLLEGE, CHENNAI.

THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY,

GUINDY,

CHENNAI – 600 032.

APRIL 2016.

CERTIFICATE

This is to certify that, the dissertation titled "**COMPARISON OF ACCURACY OF DIAGNOSTIC MODALITIES WITH OPERATIVE FINDINGS AND FACTORS PREDICTING PROGNOSIS IN PATIENTS WITH BLUNT ABDOMINAL TRAUMA**" is the bonafide work done by DR.M.KARTHIKEYAN during his M.S. General Surgery course 2013 – 2016, done under my supervision and is submitted in partial fulfillment of the requirement for the M.S. (BRANCH 1) – GENERAL SURGERY of the Tamilnadu Dr. M.G.R. Medical University, April 2016 examination.

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DECLARATION

I, **Dr. M.KARTHIKEYAN,** certainly declare that this dissertation titled "**COMPARISON OF ACCURACY OF DIAGNOSTIC MODALITIES WITH OPERATIVE FINDINGS AND FACTORS PREDICTING PROGNOSIS IN PATIENTS WITH BLUNT ABDOMINAL TRAUMA**" represents a genuine work of mine. The contributions of any supervisors to the research are consistent with normal supervisory practice and are acknowledged. I also affirm that this bonafide work or part of this work was not submitted by me or any others for any award, degree or diploma to any other university board, either in India or abroad. This is submitted to the Tamilnadu Dr. M.G.R. Medical University, Chennai in partial fulfillment of the rules and regulations for the award of Master of Surgery degree Branch 1 (General Surgery).

Dr. M.KARTHIKEYAN

Date:

Place:

ACKNOWLEDGEMENT

I hereby wish to express my heartfelt gratitude to the following persons without whose help this study would not have been possible.

I thank the Dean **Prof. Dr. R.Vimala, M.D**., for allowing me to conduct this study in Rajiv Gandhi Government General Hospital, Chennai.

My profound gratitude to **Prof. Dr. P.Ragumani, M.S.**, Professor and Director in-charge of the Institute Of General Surgery for having guided me throughout the period of this work at Madras Medical College, Chennai.

My sincere thanks to my chief **Prof. Dr. T.S.Jayashree, M.S., D.G.O.,** for her guidance and supervision throughout my career and in carrying out this dissertation.

I am thankful to my Assistant Professors **Dr.J.Selvaraj, M.S., Dr.D.Tamilselvan, M.S., Dr.D.Manivannan, M.S., Dr.P.Ramadoss, M.S.,** and **Dr.A.Varun, M.S.,** for their valuable advice, help and encouragement they rendered in the period of my study.

I sincerely thank my family, my colleagues and junior post graduates for their help and support. Last but not the least I thank all my patients for their kind co-operation in carrying out this study successfully.

Dr. M.KARTHIKEYAN, M.S.

INSTITUTIONAL ETHICS COMMITTEE
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To
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Dear Dr.Karthikeyan M,

The Institutional Ethics Committee has considered your request and approved your study titled **"Comparison of accuracy of diagnostic modalities with operative findings and factors predicting prognosis in patients with blunt abdominal trauma" No.17062015.**

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13.	Tmt.Arnold Saulina, M.A., MSW.,	: Social Scientist

We approve the proposal to be conducted in its presented form.

The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

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ABSTRACT

COMPARISON OF ACCURACY OF DIAGNOSTIC MODALITIES WITH OPERATIVE FINDINGS AND FACTORS PREDICTING PROGNOSIS IN PATIENTS WITH BLUNT ABDOMINAL TRAUMA

AUTHOR : Dr. M.KARTHIKEYAN

GUIDE : PROF. T.S.JAYASHREE M.S., D.G.O.,

INTRODUCTION:

Blunt abdominal trauma is a leading cause of morbidity and mortality in all age groups. Identification of serious intra-abdominal pathology is mostly challenging as most of the injuries may not manifest in the initial assessment and resuscitation period. Ultrasound abdomen is the investigation of choice in hemodynamically unstable patients. CT abdomen is the criterion standard for assessing solid organ injuries in hemodynamically stable patients. Non operative management is emerging as the standard of care and Laparotomy is done in hemodynamically unstable patients.

AIMS OF THE STUDY:

To study the epidemiological analysis of patients presenting with blunt abdominal trauma, to compare the diagnostic accuracy of various investigation modalities with intra-operative findings and to study factors predicting prognosis in blunt injury abdomen.

MATERIALS AND METHODS:

This combined retrospective - prospective study will be hospital based time bound study. All those cases which satisfy the inclusion criteria will be included in this study. Duration of study will be from July 2014 to June 2015. All patients admitted with isolated blunt abdominal trauma will be taken into the study after obtaining written informed consent. Data will be collected in the form of detailed history, clinical examination and investigations (radiological investigations), intra operative findings and ultimate outcome of the patients.

RESULTS:

Road traffic accidents are responsible for the majority of cases. Adolescents and young adult men are often affected. Spleen is the most common organ affected. FAST is accurate in detection of hemoperitoneum in most solid organ injuries. Four quadrant aspiration is a useful adjunct. CT abdomen is the gold standard for characterization of solid organ injuries. The overall mortality rate is around 30%. The factors associated with mortality are old age, delay, shock, prolonged surgery and postop mechanical ventilation.

CONCLUSION:

FAST is useful in identifying free fluid and four quadrant aspiration is a useful adjunct. CT abdomen is the gold standard investigation. The factors associated with mortality are old age, delay, shock, prolonged surgery and postop mechanical ventilation.

KEYWORDS

Blunt injury abdomen; FAST; Four quadrant aspiration; CT abdomen; Non-operative management; Laparotomy; Prognosis

CONTENTS

INTRODUCTION

Blunt abdominal trauma is one of the leading causes of morbidity and mortality in all age groups. Road traffic accidents are responsible for majority of the cases followed by falls and recreational/industrial accidents. Identification of serious intra-abdominal pathology is mostly challenging as most of the injuries may not manifest in the initial assessment and resuscitation period.

Initial assessment in emergency department is in accordance with ATLS protocol followed by a detailed secondary survey to look for intra-abdominal pathology. Initial assessment is often difficult and inaccurate due to the mental status of the patient. Any patient with hemodynamic instability not responding to aggressive fluid resuscitation must be suspected to have serious intra-abdominal hemorrhage.

The most common organs involved are the spleen, liver, small bowel, kidney, duodenum, bladder, pancreas, large bowel and diaphragm. Ultrasound abdomen is the investigation of choice to identify free intraperitoneal fluid in hemodynamically unstable patients. It has largely replaced diagnostic peritoneal lavage (DPL) which may be of using in cases when ultrasound is inconclusive. Contrast enhanced CT abdomen is the investigation of choice in hemodynamically stable patients. It remains the criterion standard for assessing solid organ injuries. It can determine the source of bleeding and can help in guiding treatment. Diagnostic laparoscopy is sometimes useful.

Majority of cases can be managed conservatively if patient is hemodynamically stable. Hemodynamically unstable patients due to solid organ injuries and patients with hollow viscous injuries may need emergency laparotomy and appropriate treatment.

This is a prospective and retrospective study conducted at Rajiv Gandhi Government General Hospital, Chennai in patients admitted to the emergency trauma ward with blunt abdominal injury over a one year period. All patients were managed according to standard guidelines. The role of radiological investigations and their correlation with operative findings were studied. The distribution of various injuries and the factors determining the prognosis were also studied.

AIMS AND OBJECTIVES

1. Study of the epidemiology of blunt abdominal trauma.
2. Comparison of the diagnostic accuracy of various modalities with intraoperative findings in surgically managed cases of blunt trauma abdomen.
3. Study of factors predicting prognosis in blunt injury abdomen.

REVIEW OF LITERATURE

Blunt injury abdomen is a leading cause of morbidity and mortality in all age groups globally due to increasing vehicular traffic and resulting accidents. The injuries may be missed due to preference given to other associated obvious major injuries to head, chest and long bones or due to altered sensorium or intoxicated state of the patient. Careful examination of the abdomen during secondary survey is vital in all polytrauma patients especially if he/she is hemodynamically unstable. Large amount of blood may accumulate without any significant findings during early physical examination. Imaging can help to establish the diagnosis and guide the mode of management. Majority of the cases can be managed successfully by non-operative method. Emergency laparotomy is needed for persistently unstable patients with evidence of peritonism. Overall prognosis is favourable with mortality ranging from 5 – 10%.

EPIDEMIOLOGY:

Although blunt injury can occur in all age groups, it most commonly affects persons between 15 and 30 years of age. Men are slightly more commonly affected than women in the ratio 3:2. In India, it commonly affects individuals in their 3rd decade of life. It is responsible for about 12.5% of all deaths in men and 7.5% of all deaths in women.

Overall 10% of all deaths worldwide occur due to blunt abdominal trauma and is the second most common cause of disability in developing countries.

ETIOLOGY:

The most common cause of blunt abdominal trauma is road traffic accidents which is responsible for about 75% of cases. The other common causes include falls, assault and industrial or recreational accidents.

PATHOPHYSIOLOGY:

Spleen is the most common organ involved followed closely by the liver. The other organs involved include the small bowel, kidneys, duodenum, bladder, pancreas, large bowel and diaphragm.

Trauma to internal organs occurs due to collision between the person and the external environment and due to acceleration/deceleration forces acting within the body on the internal organs. Three main mechanisms are involved in damage to abdominal organs, namely, Deceleration, Crushing and External compression.

Deceleration injuries occur due to differential movement of internal organs in relation to the body resulting in shearing forces which cause damage to the viscera at relatively fixed points. The common examples include Liver laceration at the site of attachment of ligamentum teres, Renal artery intimal injury, Mesenteric tears, Urethral injuries and Tears in small bowel at the level of duodenojejunal flexure or ileocecal junction.

Crushing injuries occur due to compression of intra-abdominal viscera between the anterior abdominal wall and vertebral column or posterior thoracic cage. Majority of solid organ injuries especially those involving the liver, spleen kidneys and pancreas occur due to this mechanism.

External compression injuries occur as a result of raised intra-abdominal pressure which results in rupture of the viscera in accordance with the Boyle's Law. Majority of hollow viscus perforation occur in this manner.

A less common mechanism involves fractured bony spicules/fragments causing impingement injuries to nearby organs. Examples include injuries to the urethra and bladder by pelvic fractures.

The abdomen can be arbitrarily divided into four areas, namely, intrathoracic, pelvic, retroperitoneum and true abdomen.

Intrathoracic abdomen lies under the cover of rib cage and comprises of the liver, spleen, stomach and diaphragm. Injuries to these organs cannot be detected by palpation.

Pelvic abdomen consists of the urethra, bladder, rectum, small bowel, female reproductive tract organs. Per rectal and pervaginal examinations are useful in detecting injuries to these organs.

Retroperitoneum consists of the pancreas, duodenum, kidneys, aorta and IVC. Injuries to these organs can be best detected only by imaging. True abdomen consists of small and large intestines, distended bladder and gravid uterus.

DIAGNOSIS

The diagnosis of blunt injury to abdominal organs is challenging. It lies in careful history taking, primary survey in accordance with ATLS principles, a detailed secondary survey to look for signs of intraabdominal injury and finally investigations to detect free fluid abdomen and the probable injured organ.

HISTORY:

A detailed history regarding the mechanism of injury can provide vital diagnostic clues towards possible intra-abdominal organ injury. It may not be reliable as in most of the cases it is elicited from the bystanders. It must take place in parallel with resuscitation. It includes details about the force of impact, extent of vehicular damage, ejection from the vehicle, use of safety devices like seat belts and air-bags and history of intoxication. It must also include past medical history, time since last meal and details about transportation from the accident site.

PRIMARY SURVEY:

It is initiated once the patient is received in the emergency department. It is carried out according to the principles of Advanced Trauma Life Support (ATLS) system. One must continue resuscitating the patient based on hemodynamic status and the degree of injuries as the survey is being carried out.

Airway must be secured first with endotracheal tube if necessary. Breathing pattern should be assessed and emergency needle thoracotomy / intercostal drainage tube insertion is done if there is evidence of chest injury.

Circulatory status should be assessed by recording the pulse rate and blood pressure. Aggressive resuscitation is done with intravenous fluids and blood products in all patients who are hemodynamically unstable.

SECONDARY SURVEY:

It comprises head to foot examination of the patient to look for various injuries. Head, spinal, long bone injuries must be specifically looked for and management planned accordingly. With respect to blunt abdominal injury, frequent serial abdominal examinations is necessary in case of strong suspicion. The primary objective of the physical examination in abdominal trauma is to rapidly identify those who need emergency laparotomy**.** Abdomen is a diagnostic black box. Injuries may be missed during initial examination as other injuries may divert the attention or patient may be in mental obtundation or in inebriated state. Nasogastric tube insertion and catheterization is necessary in all patients. Missed injuries are a major cause of morbidity and mortality in those surviving the initial phase.

The most reliable symptoms and signs in alert patients include pain, tenderness, evidence of gastrointestinal hemorrhage, hypovolemia and peritoneal irritation. Physical examination is often unreliable. Supporting findings include lap seat belt marks which may indicate possibility of small bowel injury; steering wheel marks which may indicate liver or splenic injury; lower chest wall crepitations/instability and evidence of retroperitoneal bleed in the form of Cullen's sign (umbilicus) and Grey-Turner sign (flanks) which present late after few hours or even days.

Examination of abdomen may reveal distension, guarding/ rigidity and percussion tenderness. Diaphragmatic injury may be indicated by the hearing of bowel sounds in the chest. Per-rectal examination may reveal pelvic fracture, blood staining of gloved finger, high riding prostate and loss of sphincter tone.

WORK UP:

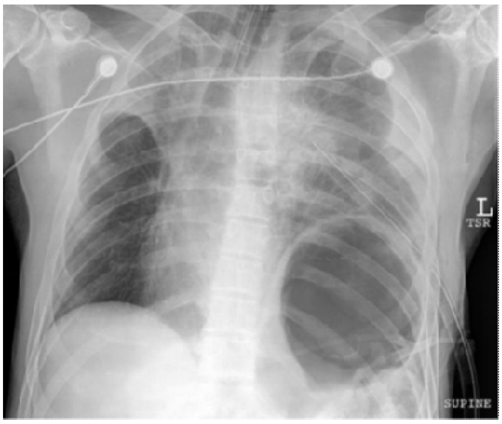
All Patients with suspected blunt abdominal trauma should be subjected to a battery of investigations which consists of hemogram, liver and renal function tests, urine analysis and coagulation profile which might be repeated as frequently as necessary.

Hemogram might reveal low hemoglobin level which indicates major ongoing bleed in a previously healthy patient. Altered renal parameters in the form of raised urea and creatinine might indicate onset of renal shutdown due to hypovolemia/shock. Elevated hepatic enzyme levels may suggest major liver injury. Persistent hyperamylasemia may indicate perforation of hollow viscus or pancreatic injury and is one of the indications for emergency laparotomy in a hemodynamically unstable patient. Urine analysis may reveal hematuria due to renal tract injury. Coagulation profile must be done to rule out bleeding diathesis, DIC and before urgent exploration.

Blood should be sent for grouping and cross matching in all cases upon arrival in emergency room. Failure of hypovolemia to respond to the initial fluid challenge of 2L of crystalloids is an evidence of major ongoing blood loss and blood must be transfused immediately. If blood of patients' blood group is not available, it is safe to transfuse O-ve blood in cases of absolute emergency.

CHEST/ABDOMINAL X-RAY:

The role of x-rays in the diagnosis of blunt abdominal trauma is limited. Chest x-ray showing bowel loops in the chest indicates ruptured hemi-diaphragm. Air under diaphragm or Rigler's sign in abdominal x-ray indicates pneumoperitoneum due to possible hollow viscus perforation. X rays can also show fractures of Dorsolumbar spine / transverse processes and loss of psoas shadow thereby providing indirect clues to possible retroperitoneal organ injuries. Duodenal injury can be suspected by the finding of retroperitoneal air-trapping around the kidneys. Pelvic plain films are of benefit in those patients who arrive with haemodynamic abnormalities. They may help in identifying a fracture pattern with potential for haemodynamically significant blood loss.



CXR indicating diaphragmatic injury suggested by fundal gas shadow in the left hemithorax

X ray showing pubic ramus fracture

FOUR QUADRANT TAPPING:

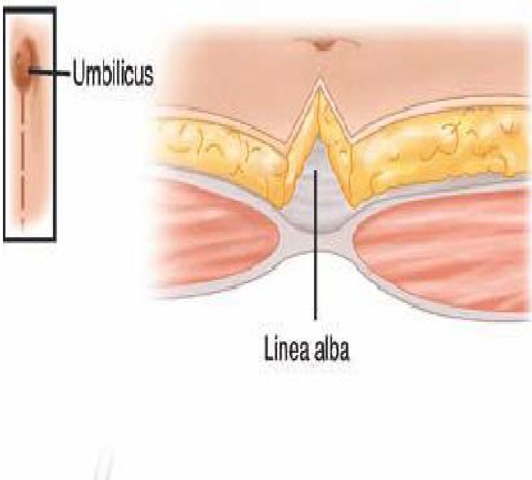
It is one method of diagnostic aspiration of intraperitoneal free fluid. A large bore needle is used and aspiration of Gas, Intestinal contents or Blood which doesn’t clot indicate possible visceral injury. It has a very low sensitivity. A negative tap doesn’t rule out abdominal organ injury. It is not being followed routinely and is recommended only by a few. However, it can be easily performed.

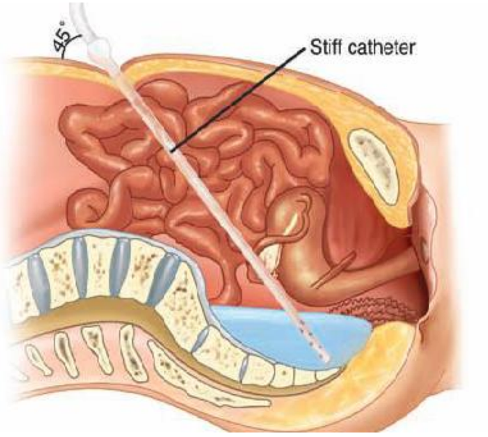
DIAGNOSTIC PERITONEAL LAVAGE:

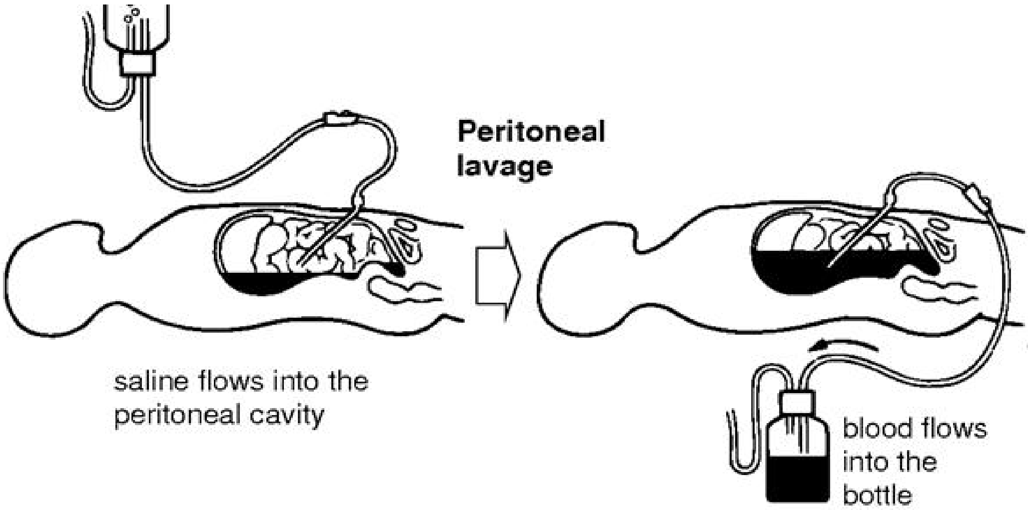
It was first utilized as a diagnostic tool in blunt abdominal trauma by Hauser Root in 1965. It is particularly of use in patients with hemodynamic instability with negative or equivocal FAST examination, in persons with suspected bowel injuries, in intoxicated/unconscious individuals and in those requiring emergency surgery for extra-abdominal injuries. It rapidly confirms the presence or absence of intra-peritoneal bleed. It is the most sensitive test for mesenteric and hollow viscus injuries. It has, however, low specificity.

It is done using a peritoneal dialysis catheter or alternatively using a Foley's catheter of 8-10Fr size. It can be done by open, semi-open or closed techniques. Bladder must be emptied and nasogastric tube should be inserted prior to the procedure to avoid bladder or gastric injuries. Under local anesthetic infiltration, a 3cm sub-umbilical vertical incision is made. Linea alba is incised and peritoneum grasped with forceps and a purse-string suture is inserted. A 2-3mm incision is made and PD catheter is introduced down into the pelvis and purse-string suture tightened.

Entry of blood into the catheter indicates positive test and the procedure can be terminated. If no blood enters, one litre of isotonic saline is infused into the peritoneal cavity and the lavage fluid allowed to drain by gravity.







Positive test is indicated by drainage of >10 ml of frank blood on insertion of the catheter or presence in the lavage fluid of RBCs > 1, 00,000/mm^3 or WBCs > 500/mm^3. It is also positive if amylase/bilirubin / ALP levels are high or when bile/ vegetable matter/ bacteria are present in the lavage fluid. The observation of effluent draining through a chest tube, a nasogastric tube, or a Foley catheter also constitutes a positive result.

Obvious need for laparotomy is an absolute contraindication for DPL. The relative contraindications include morbid obesity, previous history of surgery, pregnancy, coagulopathy and abdominal wall infection. The complications of the procedure include bleeding, spread of infection into abdomen and injury to viscera. The disadvantages include lack of organ specificity, invasiveness, false positive result due to inadvertent vessel injury or entry through rectus sheath hematoma, false negative result due to comparmentalisation or blockage and inability to detect retroperitoneal and diaphragmatic injuries.

DPL is rarely being done now-a-days for selective cases only and is being replaced by FAST and CT abdomen.

ULTRASOUND

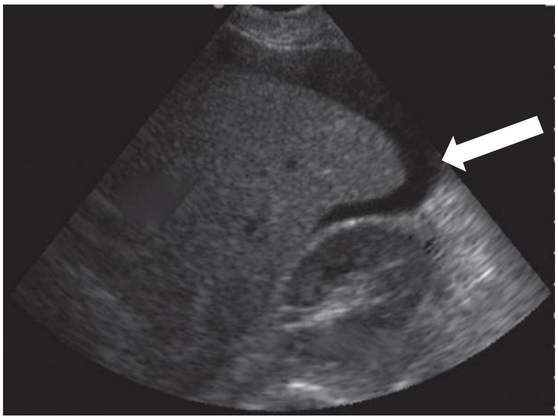
The use of ultrasound abdomen as a diagnostic tool in blunt trauma began in the 1970s. It is the investigation of choice in a hemodynamically unstable trauma patient to detect the presence or absence of intraperitoneal free fluid.

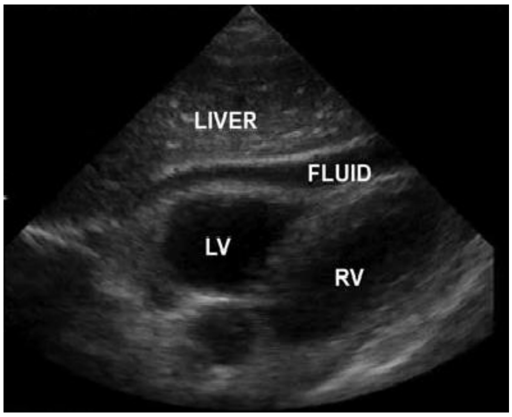
FAST (Focused Assessment with Sonography in Trauma) is a rapid bed-side evaluation done by emergency surgeons and radiologists to look for free intraperitoneal/pericardiac fluid in trauma patients. It is simple, easy to perform, cost-effective, non-invasive and accurate and involves no radiation exposure.

It relies on the presence of hemoperitoneum for the diagnosis of intra-abdominal organ injury. It is used to examine four areas (acoustic windows): Pericardium, Perihepatic/hepatorenal pouch, Perisplenic and Pelvic regions. FAST examination is considered positive if free fluid is detected in any one of the four windows and negative if no fluid is detected. Free fluid is seen as an anechoic black stripe in B-mode ultrasound.

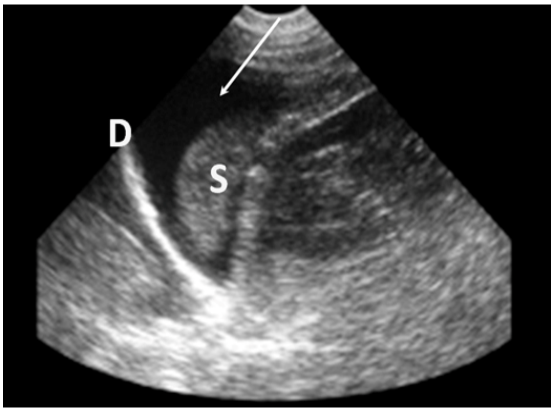
The pericardiac window is used for the detection of hemopericardium which is indicated by the separation of parietal and visceral layers of the pleura. The perihepatic window is used to demonstrate the presence of hemoperitoneum in the right pleural cavity, hepatorenal pouch and subdiaphragmatic space.

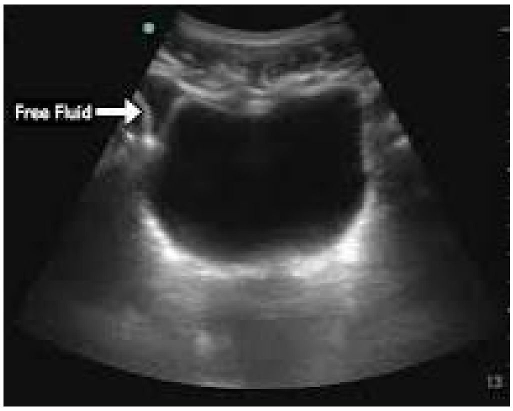
The perisplenic window is used to examine the left pleural space, the splenorenal recess and the left subdiaphragmatic space for free fluid. The pelvic window is used to detect free fluid in and around the bladder and in the pouch of Douglas in case of females.





Free fluid in hepatorenal pouch *Hemopericardium*





Perisplenic collection *Free fluid in the pelvis*

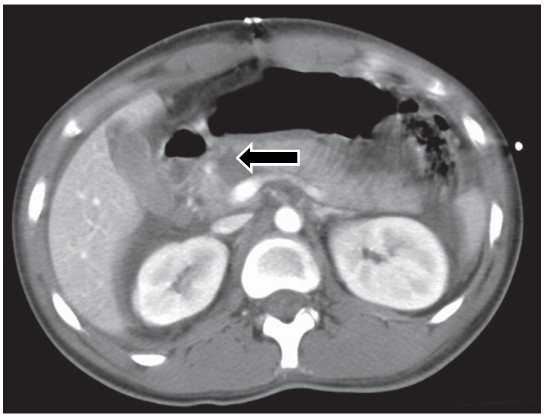
A minimum of 70ml of free intraperitoneal fluid is necessary for a positive FAST examination. It can be repeated at frequent intervals based on the hemodynamic status of the patient. **eFAST (extended FAST)** has been recently introduced with the addition of Bilateral Anterior Chest Sonography to the routine examination to detect hemothorax / pneumothorax.

The disadvantages of FAST are its operator dependence, relative lack of organ specificity, obscuration by bowel gas and obesity.

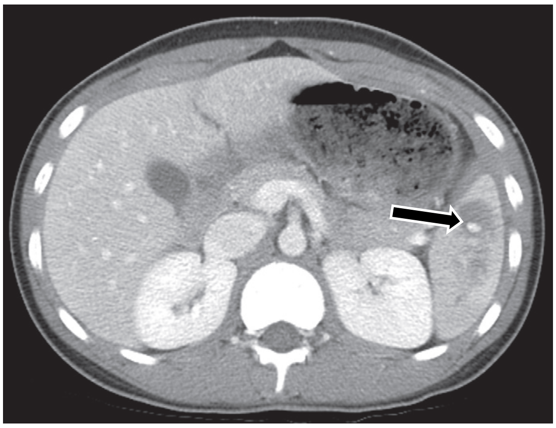
CT ABDOMEN

Contrast enhanced computed tomography (CECT) of the abdomen is the imaging modality of choice in hemodynamically stable patients with suspected blunt abdominal injury. It is the standard for detection of solid organ injuries. It provides the most detailed images of the traumatic pathology. It is an excellent imaging modality for retroperitoneal structures like the pancreas, duodenum and genitourinary system. A hemodynamically stable patient with a positive FAST examination should be subjected to CT scan for determining the nature and extent of injuries so as to guide management.

Unlike FAST or DPL, CT can detect the source of hemorrhage and can help in quantifying the amount of blood/free fluid. It can also detect other associated injuries like vertebral and pelvic fractures. Active bleeding can be detected by the presence of contrast extravasation within injured solid organs.



CT showing pancreatic injury



CT - Active contrast extravasation within spleen

The Critical limitation of CT scan in abdominal trauma is the identification of hollow viscus and diaphragmatic injuries. The sensitivity for detection of hollow viscus injuries on CT scan is relatively low. It can be improved by using high resolution scans and increasing the number of cuts. These injuries are indicated by focal areas of bowel thickening or peri-serosal fat stranding or by the presence of pneumoperitoneum.

The AAST (American Association for the Surgery of Trauma) Organ Injury Scale (OIS) grading system of various organ injuries is based on the findings on the CT scan and can help in guiding the treatment plan. The primary advantage of CT scan is its high specificity and use for guiding non-operative management. Drawbacks include prolonged time required for the procedure, the chance to miss injuries to diaphragm and perforation of bowel, expensiveness and possibility of adverse reactions to intravenous contrast agent.

DIAGNOSTIC LAPAROSCOPY:

The role of diagnostic laparoscopy as a part of diagnostic armamentarium in blunt abdominal trauma is limited due to technical reasons. It is indicated in suspected cases with negative imaging findings. The major limitations of laparoscopy include the technical difficulty in ‘running’ the bowel, the inability to diagnose retroperitoneal injuries and the difficultly of adequately exposing deep lying organs such as the spleen. It may miss pancreatic injuries and bowel perforation even if done by an experienced laparoscopic surgeon. It may, however, be useful in detecting diaphragmatic injuries. It may help to reduce negative laparotomy rate in stable patients. Contraindications include hemodynamic instability, evidence of peritonitis or sepsis and previous abdominal surgeries.

RIGID SIGMOIDOSCOPY

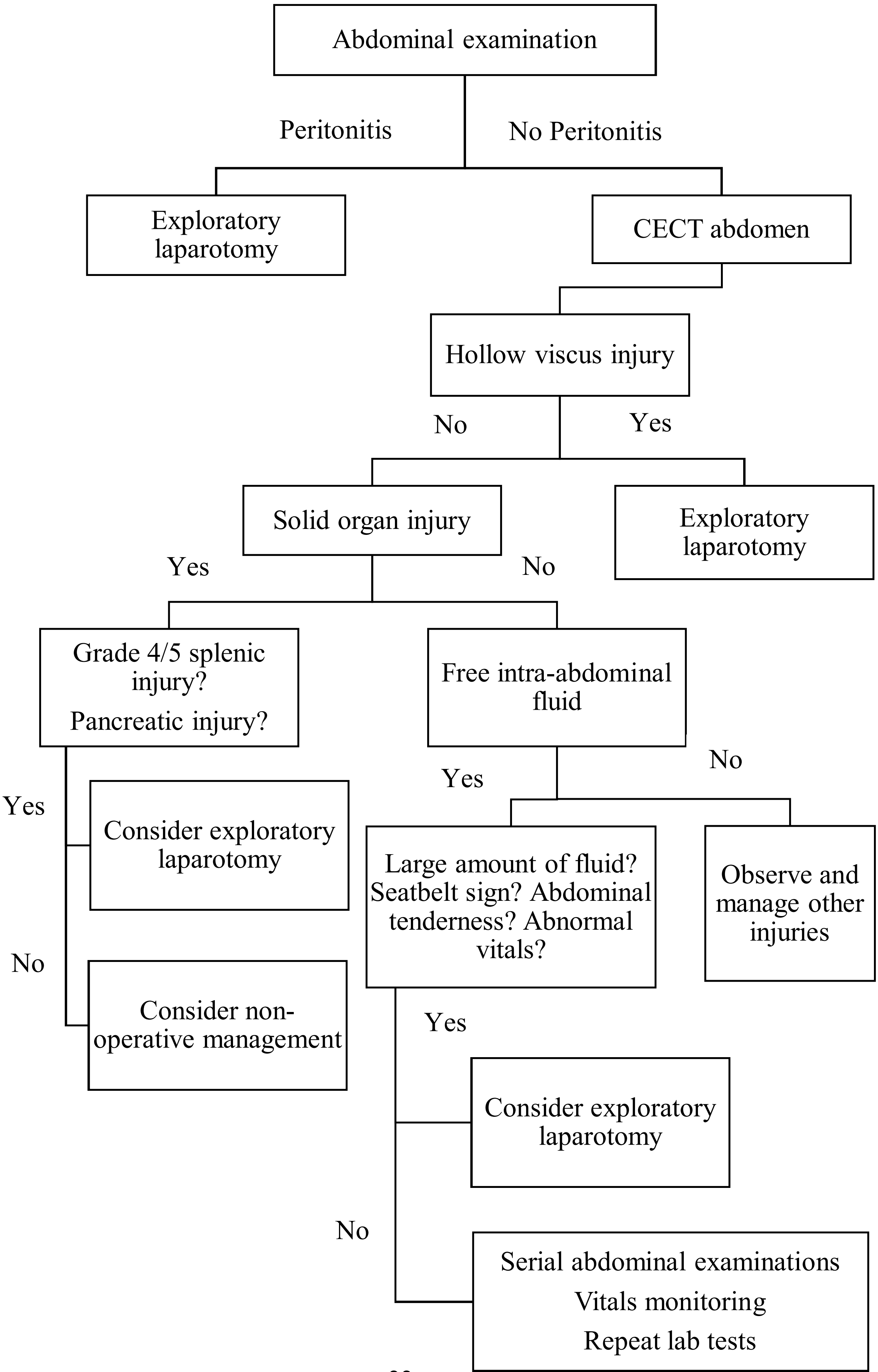
Rigid sigmoidoscopy is useful in the evaluation of the extraperitoneal portion of the rectum. Injuries to this part may not produce symptoms until septic complications develop prompting further investigations. In patients with suspected extraperitoneal rectal injuries, the per-rectal examination is often unreliable. Rigid sigmoidoscopy can be performed in the emergency department or the operating room. Gross blood or other signs of injuries indicate need for further evaluation and treatment.

TREATMENT

The treatment of a patient with blunt abdominal trauma begins with resuscitation starting from the site of accident and continuing at the emergency department as discussed earlier. Hemodynamic stability is the most important factor determining the next line of management which may be either Conservative (non-operative management or exploratory laparotomy).

Non-operative management is emerging as the standard of care in hemodynamically stable patients. It is guided by the findings on the CT scan. Frequent physical examination, monitoring of vitals and investigations as necessary must be done and recorded during this period. Blood and blood product transfusion is given as necessary. Angiography and embolization of bleeding vessel can be attempted in cases of active bleeding. Majority of the patients (80-90%) respond well to conservative line of treatment.

Exploratory laparotomy is indicated in hemodynamically unstable patients with positive FAST or DPL and not responding to aggressive fluid resuscitation; in those exhibiting signs of peritonitis or sepsis; in those with severe organ injuries and massive hemoperitoneum as demonstrated on CT scan; in patients with suspected hollow visceral injuries and in those who show evidence of deterioration during the course of non-operative management. It may a formal laparotomy and definitive management in the same sitting or damage control surgery followed later by definitive procedure.


Abdominal examination
Peritonitis
No Peritonitis
Exploratory laparotomy
CECT abdomen
Hollow viscus injury
No
Yes
Solid organ injury
Exploratory laparotomy
Yes
No
Grade 4/5 splenic injury?
Pancreatic injury?
Free intra-abdominal fluid
Yes
Consider exploratory laparotomy
No
Consider non-operative management
Yes
No
Large amount of fluid? Seatbelt sign? Abdominal tenderness? Abnormal vitals?
Observe and manage other injuries
Yes
Consider exploratory laparotomy
No
Serial abdominal examinations
Vitals monitoring
Repeat lab tests

The primary goals of trauma laparotomy are rapid control of exsanguination, control and minimisation of bowel spillage and avoidance of the lethal triad of hypothermia, coagulopathy and acidosis. Patients who require laparotomy should undergo a systematic exploration so that all areas are assessed and injuries not missed. This approach may require truncation in the setting of deteriorating physiologic condition wherein the concept of Damage Control Surgery is followed. Preinduction broad-spectrum antibiotics need to be administered.

The standard approach is to open the abdomen in the midline from xiphoid process to pubic symphysis to provide adequate exposure. The falciform ligament is divided, separating the liver from the anterior abdominal wall to improve retraction and packing. Blood and clots are quickly evacuated from all four quadrants and laparotomy pads are placed to provide temporary hemostasis. Packing starts in the quadrant with the most suspicion for an injury and proceeds towards the area of least suspicion.

Bleeding always needs to be addressed first. Prior to pack removal, the zones of the retroperitoneum need to be assessed. Should these demonstrate large or expanding haematomas, the anaesthetist should be promptly informed of the increased risk for massive blood loss, adequate blood and blood products should be readily made available and whether proximal and distal control are needed prior to proceeding with exploration is to be determined. If otherwise, packed sponges are removed to look for bleeding. While removing the packs reverse order should be followed. The packs in the quadrant in which injury is not expected are to be removed first and progressed to the quadrants with suspicion for an injury. Hemostasis is achieved if the cause could be located or else the packs are replaced in the damage control setting. If packing does not control the ongoing haemorrhage, active intraperitoneal bleeding from the great vessels or from the porta/retrohepatic area must be seriously considered and dealt with according either by repair or temporary bypass.

Once the bleeding has been controlled, next, the entire gastrointestinal tract is carefully evaluated from the esophago-gastric junction to the rectum. This also includes entering the lesser sac to evaluate the posterior surface of the stomach and the pancreas. Areas stained with blood that are of concern for injury should be explored further with careful dissection and the injuries identified are dealt with accordingly.

Developing physiologic compromise should be promptly identified; this requires continuous interaction with the anaesthetists throughout the surgery duration. In such a situation, the operation must be abbreviated, with the only objectives being control of haemorrhage and contamination with temporary abdominal closure. Otherwise, the abdominal fascia can be closed in a single layer and the subcutaneous wound addressed as per the degree of intra-abdominal contamination.

SPLENIC TRAUMA

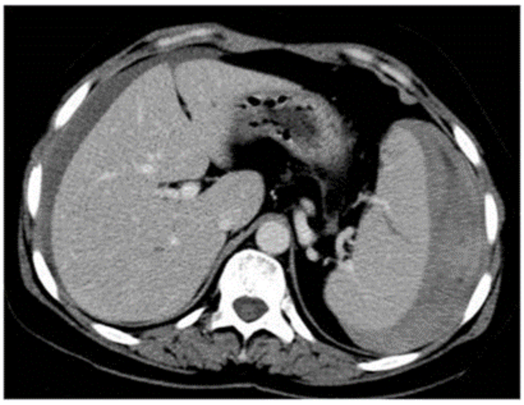
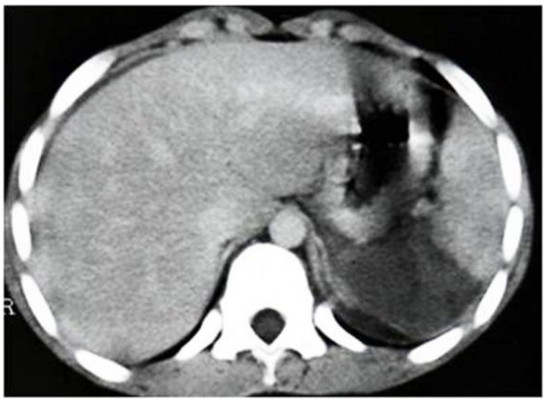
The spleen is the most commonly injured intra-abdominal organ in blunt trauma accounting for nearly half of the cases. A significant mortality of around 10% is associated with blunt splenic injury many of which are related to associated injuries and prehospital delays. The mechanisms of splenic injury include direct compression in the left upper quadrant of the abdomen or a deceleration mechanism that tears the splenic capsule or parenchyma, mainly at areas fixed or tethered to the retroperitoneum.

Presentation

The main concern is internal haemorrhage which can be mild or profuse depending on the severity of the injury. A patient with active bleeding usually presents with left upper quadrant pain, progressing abdominal distension or features of shock. Bleeding from a ruptured spleen can be ongoing at the time of presentation or frequently could have stopped. This cessation of bleeding allows many of the injuries to be managed conservatively, though re-bleeding can occur and be delayed for few days or even up to weeks. This is of concern for patients undergoing non-operative management. Identification of splenic injuries may occur during laparotomy in hemodynamically unstable patients who are taken emergently to the operating theatre. Any patient with unexplained left upper quadrant pain with features of shock or peritonitis must be inquired about any recent history of trauma.

Investigations

Unstable patients with intra-abdominal fluid on FAST examination require exploration, with spleen commonly being the bleeding organ. In stable patients, abdominal CT performed with IV contrast is the mainstay for diagnosing and characterizing splenic injuries. Splenic injuries appear as disruptions in the normal parenchyma with surrounding hematoma and free intra-abdominal blood. Occasionally, active extravasation of contrast can be seen, contained within a pseudoaneurysm or bleeding into the peritoneal cavity. Other findings can include a hematoma confined to the subcapsular area or even complete devascularisation caused by injury to the hilar vessels.

Perisplenic hematoma *Major splenic devascularisation*

Spleen injury grading (AAST) relies on description of the parenchymal or subcapsular characteristics and the presence of vascular involvement.

GRADE	INJURY TYPE	DESCRIPTION OF INJURY
I	Hematoma Laceration	Subcapsular <10% surface area Capsular tear < 1 cm depth
II	Hematoma Laceration	Subcapsular 10-50% surface area ; Intraparenchymal hematoma <5 cm in diameter 1-3 cm depth (not involving trabecular vessels)
III	Hematoma Laceration	Subcapsular >50% surface area or expanding; Intraparenchymal hematoma > 5 cm or expanding; Ruptured hematoma > 3 cm depth or involving trabecular vessels
IV	Laceration	Laceration involving segmental or hilar vessels with major devascularisation (>25%) of spleen
V	Laceration Vascular	Shattered spleen Hilar vascular injury with complete devascularisation of spleen

A more recent advancement in the management is the use of angiography. It is being used for injuries that demonstrate active extravasation of contrast on the CT scan. It can identify specific sites of bleeding. However, it cannot characterize the parenchymal injury. It can be complementary to CT. One major benefit is its potential to arrest sites of bleeding using angioembolization. Patients who are candidates for nonoperative management but demonstrate a contrast blush on CT may benefit from angiography with embolization to eliminate the splenic pseudoaneurysm. Only those patients who are not in a state of shock and demonstrate hemodynamically stability should be considered for angiographic evaluation and treatment.

Non-operative management

With appropriate patient selection, many patients with blunt splenic trauma can be managed without splenectomy. To be a candidate for nonoperative management, hemodynamic stability is a prerequisite and must be present without ongoing intravascular fluid support which is indicated by a normal blood pressure and lack of tachycardia, no physical examination findings indicating shock, and absence of metabolic acidosis. Patients who have experienced transient hemodynamic instability that responded to crystalloid infusion may be considered but one should always maintain a lower threshold for surgery in these patients. It is to be reserved for minor grades (I – III) of injuries. Splenic artery embolization can also be tried.

Operative management

Laparotomy is indicated in the setting of hemodynamic instability at admission or after failed non-operative management; in the presence of other associated injuries and in elderly (>55 years) due to increased risk of rebleeding. The best approach is through a midline incision with evacuation of hemoperitoneum and packing of all four quadrants. Splenectomy is the procedure of choice in most cases.

Splenectomy begins with division of the lateral peritoneal attachments which is facilitated by retracting the spleen posteromedially. The dissection begins at the splenocolic ligament by dividing the peritoneum at the white line of Toldt and then continuing superiorly until the short gastric vessels are reached. After the peritoneum is taken down, a plane is created by blunt dissection posterior to the spleen in a medial direction, extending behind the tail of the pancreas. This manoeuvre mobilizes the entire spleen and the distal pancreas, which allows the spleen to be delivered into the midline wound. The short gastric vessels are then identified and ligated, with care taken to avoid injuring the greater curvature of the stomach. Finally, the hilar vessels are clamped and ligated, ensuring not to include the tail of the pancreas which can lead to pancreatitis or external fistula. Drains need not be placed unless there is concern that the tail of pancreas is injured as their use is associated with subphrenic abscess.

In the setting of damage control surgery, the splenic injury can be managed by packing but, more commonly, splenectomy is done as it can be done rapidly. Postsplenectomy vaccines must be provided to ensure protection from encapsulated bacteria, namely Pneumococcus, Neisseria Meningitidis and Hemophilus influenzae.

Until 1970s, splenectomy was considered mandatory for all splenic injuries. Recognition of the immune function of spleen refocused efforts on operative splenic salvage in the 1980s. Several splenic salvage options exist like spleenorraphy, partial splenectomy or enveloping in a mesh bag. Haemostasis can be achieved by ligation of, or application of, metal clips to intrasplenic vessels, and by careful application of topical haemostatic means like electrocautery; argon beam coagulation; application of thrombin-soaked gelfoam sponges, fibrin glue, or BioGlue or mesh or pledgeted suture repair.

LIVER TRAUMA

The liver is the second most common organ injured in blunt abdominal trauma. Its large size and ligamentous attachments make it particularly vulnerable to get injured though it is partially protected by the rib cage. It is often associated with splenic, mesenteric or renal injuries. Mechanisms of blunt hepatic trauma include compression forces with direct parenchymal damage and shearing forces causing tearing of the hepatic tissue and disruption of vascular and ligamentous attachments.

Presentation

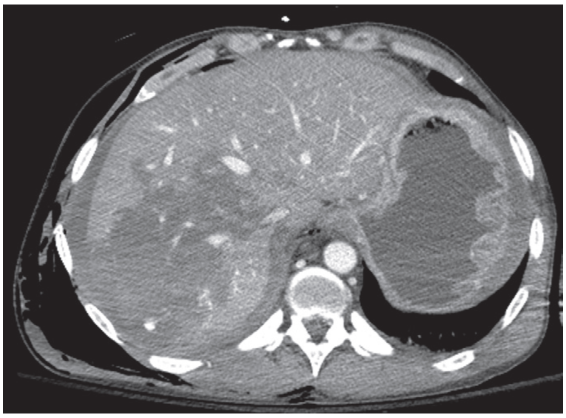
The liver is an extremely well-vascularised organ, and blood loss is therefore the major early complication following hepatic injuries. Clinical suspicion of a possible liver injury is essential. Severe crushing injuries to the lower chest or upper abdomen often combine rib fractures, haemothorax and damage to the spleen and/or liver.

Investigations

In hemodynamically unstable patients, FAST performed by an experienced operator can reliably diagnose free fluid abdomen. Owing to the opportunity for massive ongoing blood loss and the rapid development of coagulopathy, the patient should be directly transferred to the operating theatre while blood products are being obtained and volume replacement is taking place.

Patients who are haemodynamically stable should have a contrast enhanced CT scan as the next step. Findings on CT include disruption of hepatic parenchyma with perihepatic blood or hematoma, as well as hemoperitoneum. Occasionally, contrast extravasation is visualized as a high-density blush indicating the presence of a pseudoaneurysm or active bleeding outside of the Glisson's capsule. It can be used to characterize the injury according to the AAST Organ Injury Scale which involves grading based on the extent of parenchymal involvement in the form of contusion or laceration and presence or absence of vascular injury.

GRADE	INJURY TYPE	DESCRIPTION OF INJURY
I	Hematoma Laceration	Subcapsular <10% surface area Capsular tear < 1 cm parenchymal depth
II	Hematoma Laceration	Subcapsular 10-50% surface area ; Intraparenchymal <10 cm in diameter 1-3 cm depth , < 10cm length
III	Hematoma Laceration	Subcapsular >50% surface area or ruptured/expanding hematoma ; Intraparenchymal hematoma > 10 cm > 3 cm depth
IV	Laceration	Parenchymal disruption 25-75% of a hepatic lobe
V	Laceration Vascular	Parenchymal disruption >75% of hepatic lobe or >3 couinaud segments of a lobe Juxta-hepatic venous injuries (Retrohepatic IVC, major hepatic veins)
VI	Vascular	Hepatic avulsion



Grade III liver laceration *Grade III Subcapsular hematoma*

Non operative management

Most patients with blunt injury liver who are haemodynamically stable can be managed conservatively. To qualify for nonoperative management, patients must demonstrate evidence that the bleeding has stopped. This is typically indicated by the absence of tachycardia, hypotension, metabolic acidosis and evidence of shock, being sure that the patient is not receiving ongoing fluid resuscitation that might mask cardiovascular compromise. Physiologic stability is the major predictor of successful non-operative management of hepatic trauma. This is true independent of the injury severity, such that even high- grade liver injuries should be considered for nonoperative management as long as the patient remains hemodynamically stable, without evidence of active bleeding.

The indications for discontinuing non-opeartive treatment include development of haemodynamic instability, appearance of signs of generalised peritonitis and evidence of ongoing blood loss.

Interventional radiology has an important role in the management of liver trauma and embolisation to control hepatic artery bleeding is safe and effective in a hemodynamically stable patient with no evidence of hollow viscus perforation. Even with successful embolization, patients need routine surveillance as required for all hepatic injuries managed non-operatively. The indication for angiography to control hemorrhage is transfusion of 4 units of packed cells in 6 hours or 6 units in 24 hours without evidence of hemodynamic instability. When selected appropriately, angioembolization has improved the rate of successful nonoperative management by reducing the number of conversions to laparotomy. This also allows many higher grade injuries that might have required surgery to be managed non-operatively.

Operative management

In hemodynamically unstable patients, once resuscitation has commenced, the patient should be immediately transferred to the operating theatre, with further resuscitation performed on the OT table. Fresh-frozen plasma and cryoprecipitate must be readily available as these patients are bound to rapidly develop irreversible coagulopathy as a result of a lack of fibrinogen and clotting factors. Standard coagulation profiles are inadequate to evaluate acute loss of clotting factors, and factors need to be given empirically, aided by the results of thromboelastography, if available.

Unlike for splenic trauma, the operative intervention for liver injury is less definitive and can be challenging. Good access is vital. A 'rooftop' incision with midline extension to xiphisternum and retraction of the costal margins gives excellent access. If laparotomy has been started through a midline incision, a transverse lateral extension to the right can be added to improve access to the liver. Operative management can be summarized as 4 P's namely Push, Pringle, Plug and Pack.

First, the liver is reconstituted as best as possible to its normal position and bleeding is controlled by direct compression (push). Compression of the liver with packs and correction of coagulopathy will control most of the active bleeding from the liver.

Crush injuries result in large parenchymal hematomas and diffuse capsular lacerations. Diffuse parenchymal injuries are treated by packing the liver to produce hemostasis. This is effective for majority of the injuries if the liver is packed against the natural contour of the diaphragm. Perihepatic packing which involves placing packs above, behind and below the liver, is the most useful method. Necrotic tissue, if present, should be excised, but poorly perfused, though viable, liver portions are left in situ. Large abdominal packs should be used for the ease of removal and abdomen closed to facilitate compression of hepatic parenchyma. Care should be taken to avoid overzealous packing, as it may produce pressure necrosis of the parenchyma or abdominal compartment syndrome. If packing is necessary, the packs must be removed after 48 hours to prevent infection, and usually no further intervention is required. Antibiotic cover is required and full reversal of coagulopathy, if present, is necessary.

If the bleeding persists, further control can be achieved by occluding the vascular inflow by placing an atraumatic clamp across the foramen of Winslow including the hepatoduodenal ligament (the Pringle's manoeuvre). Bleeding from hepatic artery and portal vein injuries will stop with this manoeuvre. Intermittent release of the clamp is helpful in attenuating hepatic cellular loss. Lacerations to the hepatic artery should be repaired with 6/0 Prolene suture. If unavoidable, the hepatic artery may be ligated, although it can result in parenchymal necrosis and abscess formation in some. Portal vein injuries, which have very high mortality rate (around 50%), should be repaired with 5/0 Prolene. Inflow occlusion also facilitates suturing of lacerations and vessels in the depth of the parenchyma.

Most of the hepatic lacerations can be managed with perihepatic packing and manual compression. After patient stabilization, the packs are removed and lacerations evaluated. Mild injuries with little or no ongoing bleed may be managed with further compression; topical hemostatic agents like the use of electrocautery, argon-beam coagulation, microcrystalline collagen powder impregnated in gauze, topical thrombin soaked gelfoam, fibrin glue, bioglue; or suture hepatorrhaphy with a blunt tipped absorbable monofilament buttressed horizontal mattress suture (0 chromic).

With more severe injuries, a portion of the liver may be avulsed. These are more complex as they are associated with a devitalised portion of the liver and major injuries to the hepatic veins and the IVC. If bleeding persists despite inflow occlusion, one must consider major hepatic vein or IVC injuries, and also look for aberrant vessels to the liver. If a major vascular injury is suspected, then the patient must be referred to a specialist centre.

A common surgical approach in major vascular injuries is to place the patient on venovenous bypass using a cannula in the femoral vein via a long saphenous cut-down with the blood returned to the superior vena cava, using a pump, via an internal jugular vein line. Venovenous bypass allows IVC to be safely clamped to facilitate repair. A rapid infuser blood transfusion machine facilitates delivery of large volume of blood instantaneously. Once prepared, the patient is relaparotomised. The liver is mobilized and complete vascular isolation is achieved by occluding the hilar inflow and the IVC above the renal veins and at the level of the diaphragm with atraumatic vascular clamps. Venous return is provided by venovenous bypass. Warm ischemia of the liver is tolerated for up to 45 minutes, allowing sufficient time for repair of injuries to the IVC or hepatic veins in a bloodless field.

Damage control surgery is often of major value as many patients who require operative intervention for liver injuries have physiological deterioration. This includes control of bleeding followed by aggressive perihepatic packing and temporary abdominal closure. Patients are then resuscitated in the intensive surgical care unit till the triad of hypothermia, coagulopathy, and acidosis resolve, at which time, the abdomen is re-explored and the packs removed and injuries dealt accordingly. Angiography with embolization after damage control may provide additional assistance in managing ongoing bleeding from hepatic artery branches, although the mortality is high.

Other complications of liver trauma

A subcapsular or intraparenchymal hematoma usually requires no specific intervention and is allowed to resolve spontaneously. **Abscess** can form as a result of secondary infection of an area of parenchymal ischemia. Treatment is with systemic antibiotics and percutaneous aspiration/drainage under image guidance once the necrotic tissue has liquefied.

Localized bile collections **(biliomas)** may or may not be infected. If infected, they should be treated like an abscess via percutaneous drainage. Large collections should be drained by aspiration under ultrasound guidance or percutaneous insertion of a pigtail drain. **Biliary ascites**, due to the disruption of a major bile duct, often requires reoperation and wide drainage. The site of origin of a **biliary fistula** can be determined by endoscopic or percutaneous cholangiography, and biliary decompression achieved by percutaneous transhepatic drainage or endoprosthesis insertion. If this fails to control the fistula, the affected portion of the liver may require resection.

Resectional debridement is indicated for removal of peripheral portions of nonviable parenchyma. Late vascular complications include **hepatic artery pseudoaneurysm** which have potential for rupture resulting in **arteriovenous or arteriobiliary fistulae** which can present with features of hemobilia or portal hypertension. These are best treated non-surgically by an interventional radiologist by transarterial embolization of the feeding vessel**. Biliovenous fistulas,** causing jaundice due to rapid increases in serum bilirubin levels, should be treated with ERCP and sphincterotomy**. Hepatic failure** may occur following extensive liver trauma. This will usually reverse with conservative supportive treatment if the blood supply and biliary drainage remain intact.

Long-term outcome

The capacity of liver to recover from extensive trauma is remarkable, and parenchymal regeneration occurs rapidly. Late complications are rare, but the biliary tract strictures can develop many years after recovery. The treatment depends on the mode of presentation and the extent and site of stricturing. A segmental or lobar stricture, associated with atrophy of corresponding area of liver parenchyma and compensatory hypertrophy of the other liver lobe, can be treated expectantly. A dominant extrahepatic bile duct stricture associated with obstructive jaundice can be treated initially with endoscopic balloon dilatation or stenting, but would usually require surgical correction in the form of Roux-en-Y hepatodochojejunostomy.

PANCREATIC TRAUMA

The pancreas, due to its somewhat protected location in the retroperitoneum, is infrequently damaged in blunt abdominal trauma. A damage to the pancreas is often associated with injuries to other viscera, especially the liver, the spleen and the duodenum. Occasionally, a forceful blow to the epigastrium can crush the body of the pancreas against the vertebral column. Injuries may range from a contusion or laceration of the parenchyma without duct disruption to major parenchymal destruction with duct disruption or complete transection and, rarely, massive destruction of the pancreatic head. The most important factor that determines treatment is whether or not the pancreatic duct has been disrupted.

Presentation

Blunt pancreatic trauma patients usually present with epigastric pain, which may be minor at first, with progressive development of more severe pain as a result peritonitis due to leakage of pancreatic fluid into the surrounding tissues. The clinical presentation can be deceptive; hence, a careful serial assessments and a high index of suspicion are required.

Investigations

The diagnosis of pancreatic injuries is challenging. No single imaging modality has been found to be highly effective. A rise in serum amylase occurs in most cases. Persistent high values or increasing values are of more significance. CT scan taken in the pancreatic phase will delineate the damage that has occurred. Findings on CT include malperfusion of parenchyma indicating disruption, surrounding fluid, or hematoma and stranding in adjacent soft tissue. If there is doubt about duct disruption, urgent ERCP should be sought if expertise is available. MRCP may also help, but the images can be difficult to interpret.

AAST grading of pancreatic injury:

GRADE	INJURY TYPE	DESCRIPTION OF INJURY
I	Hematoma Laceration	Minor contusion without duct injury Superficial laceration without duct injury
II	Hematoma Laceration	Major contusion without duct injury or tissue loss Major laceration without duct injury or tissue loss
III	Laceration	Distal transection or Parenchymal laceration with duct injury
IV	Laceration	Proximal transection or Parenchymal injury involving ampulla
V	Laceration	Massive disruption of pancreatic head

CT showing distal pancreatic transection

Management

Support with intravenous fluids and a nil per oral regimen should be started while investigations are performed. There is no need to rush to laparotomy if the patient is haemodynamically stable, without features of peritonitis. It is preferable to manage conservatively at first, investigate and once the extent of the damage has been determined, appropriate action to be undertaken.

Operation is indicated if there is disruption of the main pancreatic duct; in almost all other cases, the patient will recover with conservative management. Assessment of pancreatic damage and duct disruption can be difficult as bruising associated with the retroperitoneal damage prevents clear visualisation. A patient and thorough examination of the gland should be done. Complete exposure of pancreas involves mobilization of the hepatic flexure (Cattel's manoeuvre) and division of gastrocolic ligament to push the transverse colon and mesocolon inferiorly. An extended Kocherisation will mobilize the pancreatic head and body to facilitate evaluation. Assessment of the injury includes determining the degree of parenchymal damage, location of injury and presence of ductal involvement.

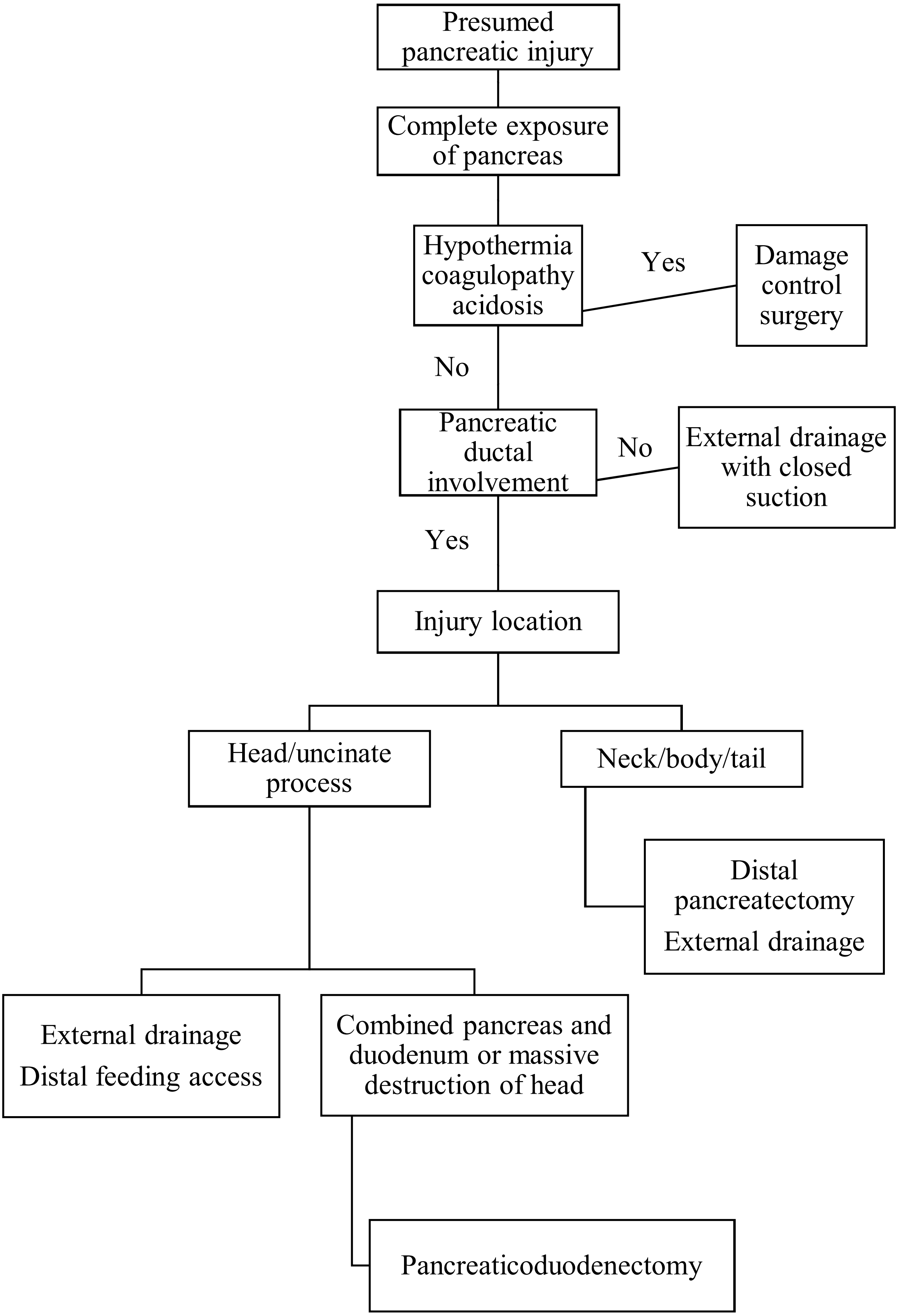
Haemostasis and closed drainage is adequate for minor pancreatic parenchymal injuries (grade I, II). Adequate external drainage is an important principle in the management of most injuries to pancreatic parenchyma. The diversion of leaking pancreatic enzymes is required to prevent devastating effects of uncontrolled accumulation of highly caustic digestive juice, which will provoke a massive systemic inflammatory response and progressive organ dysfunction. It should be done with a closed suction system because these are associated with a reduced rate of abscess formation.

The management of pancreatic injuries with ductal involvement depends on their location. Injuries to the left of superior mesenteric vessels (grade III) are managed with distal pancreatectomy, with or without splenectomy. The proximal stump can be managed by individually ligating the duct and over-sewing the parenchyma or using a stapler. The stump can be covered with omentum and a closed suction drain should be placed. However, if the plane of transection is clean and flat, it may be possible to anastomose the stump of distal pancreas to a Roux loop of jejunum as end-to-side pancreatojejunostomy. If damage is purely confined to the head (grade IV), haemostasis and external drainage is usually effective. Managing with drainage alone often successfully diverts the leakage of pancreatic fluid externally, creating a controlled fistula that will frequently close spontaneously. This healing can also be promoted with duct decompression through placement of stents via Endoscopic retrograde pancreatography.

Massive destruction of the pancreatic head (grade V) or combined pancreatic and duodenal injuries (grade IV) may require pancreaticoduodenectomy (Whipple's procedure). This can be extremely challenging and is associated with high postoperative complication rate. It requires ongoing patient stability or else the operation should be abbreviated, with later reconstruction after the physiologic condition improves. Damage control surgery includes haemorrhage control, external drainage, and temporary abdominal closure with plans for reexploration later.

Prognosis

The most common cause of death in the immediate period is bleeding, usually due to associated injuries. Once the acute phase has passed, morbidity and mortality related to the pancreatic injury itself are treatable, with complete return to normal activity being the usual outcome. Persistent drain output can occur in few patients. Duct structuring may develop leading to recurrent episodes of pancreatitis. The appropriate treatment is resection of the tail distal to the site of duct disruption. Also, a pancreatic pseudocyst may develop. If the main duct is intact, the cyst can be aspirated percutaneously or cystogastrostomy can be performed. If it develops in the presence of complete disruption of the duct, cystogastrostomy or distal resection or Roux-en-Y pancreatojejunostomy is done.



ALGORITHM FOR MANAGEMENT OF PANCREATIC INJURY

SMALL BOWEL AND MESENTERIC INJURIES

Blunt injuries to the small intestine are less common but are associated with significant mortality due to their delayed presentation in most cases as they often go unnoticed during the initial examination. Mechanisms of blunt small bowel injury include crushing, rupture, and shearing patterns. The small intestine can be crushed between the steering wheel or seatbelt and vertebral column, resulting in direct tissue injury. The rupture-type injury occurs when the intraluminal pressure increases rapidly, resulting in a blowout, usually at the antimesenteric border. Deceleration mechanisms result in shearing of the serosa or muscular layer throughout a segment of the bowel. Mesenteric injuries can cause devascularization of segments of small intestine without direct tissue injury.

Clinical features and investigations

Small intestinal injuries are predominantly identified at the time of laparotomy. Patient can present with features of peritonitis. X-ray might show intra-abdominal free air. Hollow viscous injury is suggested on CT scan by the recognition of bowel wall thickening, inflammation in the surrounding adipose tissue seen as fat stranding, or the presence of free intraperitoneal fluid. The presence of unexplained free fluid on imaging should be carefully evaluated and a high index of suspicion for bowel injury be considered. DPL may provide valuable information. Findings on lavage fluid evaluation such as more than 500 white blood cells/mm3, amylase, bilirubin, or particulate matter, have been found to be indicative of hollow viscus injury.

AAST grading of bowel injury (small bowel and colon):

GRADE	INJURY TYPE	DESCRIPTION OF INJURY
I	Hematoma Laceration	Contusion or hematoma without devascularisation. Partial thickness; without perforation
II	Laceration	<50% circumference of bowel
III	Laceration	>50% circumference without transection
IV	Laceration	Transection of the bowel
V	Laceration Vascular	Transection of bowel with segmental tissue loss. Devascularised segment

CT picture showing features of small bowel perforation

Management

Surgical management is the treatment of choice in order to prevent peritonitis. The type of repair depends on the extent of intestinal wall damage in relation to luminal circumference. Serosal tears (grade I) can be reinforced with interrupted nonabsorbable suture thereby imbricating the site of injury. Small perforations (grade II) can be closed primarily without compromising the intestinal lumen in one or two layers. This can be safely performed for even multiple perforations as long as it doesn't result in significant luminal narrowing. Alternatively, resection is done when several injuries are close together. Injuries occupying more than 50% of the wall circumference (grade III - V) should be addressed with resection and anastomosis either stapled or hand sewn techniques. Hand-sewn anastomoses are frequently made in two layers but single-layer methods are equally efficacious. Caution should be exercised with mesenteric injury, as there is a risk of significant bleeding. In cases with mesenteric haematoma, the region should be imbricated along the anti-mesenteric wall to rule out occult perforations which may have a delayed presentation.

Damage control surgical approach to small bowel injuries includes rapid closure of perforations to control contamination and/or stapled resection of the damaged segments. Patients in shock may benefit from resection without immediate anastomosis because of the related delay of the procedure and a higher risk of anastomotic dehiscence and leak. The abdomen is temporarily closed and intestinal continuity can then re-established following successful resuscitation.

COLONIC INJURY

Blunt colon and rectal injury occur in less than 2% of all blunt trauma patients. Injuries can result from similar mechanisms as those seen with the small bowel. The colonic wall can be crushed by physical forces or rupture when the impact results in a rapid elevation of the intraluminal pressure. Depending on the segment involved, perforation can occur into the retroperitoneum. The colon is also vulnerable to shearing forces, which can cause a separation of the serosa or muscle layer over a long segment. Blunt rectal trauma is associated with pelvic fractures or concussion-type injury, or due to de-vascularisation from mesenteric injury.

Clinical presentation and investigations

As with other hollow visceral injuries, colonic injuries may be identified first at the time of laparotomy undertaken due to hemodynamic instability/peritonitis. Otherwise, evaluation is as described earlier for small bowel injuries. Care must be taken to assess the segments of colon that are retroperitoneal in location. Blood identified on per-rectal examination suggests rectal involvement prompting further evaluation. Rigid procto-sigmoidoscopy helps to visualize the rectum and distal sigmoid colon to assist in determining the presence or absence of injury.

This can be performed prior to laparotomy in hemodynamically stable patients to help in planning the operative approach. Endoscopy may clearly reveal an injury or only demonstrate hematoma in the rectal wall or a large amount of blood in the rectal cavity. When possible, determining the size of injury and location on the rectal wall may be valuable when planning the necessary management. Upper third rectal injuries, especially those on the anterior and lateral surfaces, can be identified during examination of the pelvis during laparotomy.

AAST grading of rectal injury:

GRADE	INJURY TYPE	DESCRIPTION OF INJURY
I	Hematoma Laceration	Contusion or hematoma without devascularisation. Partial thickness laceration
II	Laceration	<50% circumference of rectum
III	Laceration	>50% circumference of rectum
IV	Laceration	Full thickness laceration with extension to the perineum
V	Vascular	Devascularised segment

Management

Operative repair of colonic injuries depends on the severity of the injury and the patient's overall status. Injuries that involve less than 50% of the wall circumference can be managed with primary repair in one or two layers, being sure to imbricate the mucosal edge. Primary repair is contraindicated with extensive intraperitoneal faecal spillage, extensive colonic injury requiring resection, and patients in shock and in cases of major abdominal wall loss. Usually, compromising the lumen is not a concern as against the small bowel. Destructive colon injuries that involve more than 50% of the colonic wall should be resected; many of which can then be anastomosed immediately. Injuries proximal to the middle colic artery can be managed with right hemicolectomy and creation of ileo-colic anastomosis. Distal injuries require segmental resection with colo-colic anastomosis.

In the setting of shock, immediate anastomosis is associated with an unacceptably high leak rate. There are two options in this setting. First, the injured segment can be resected and a diversion colostomy created. The second option is to resect the injured segment and leave the GI tract in discontinuity until after the patient has been adequately resuscitated. On relaparotomy, delayed primary anastomosis or creation of a colostomy can be completed. Other factors that may suggest need for colostomy instead of repair or anastomosis include significant associated injuries, underlying medical disease, and delayed injury recognition with the development of severe peritonitis.

Rectal injuries that result in perforation pose a significant risk of developing pelvic sepsis and thus require operative management. Rectal injuries involving the intraperitoneal portion can often be primarily repaired as with the colonic injuries. The mainstay in the treatment for rectal injuries are fecal diversion and presacral drainage until healing has occurred, at which time the colostomy can be reversed. This can be achieved with an end colostomy or a loop ostomy as long as complete fecal diversion can be achieved. One approach is to drain injuries that occur posteriorly or laterally in the lower third of rectum as these have likely entered the presacral space and are at greater risk of abscess formation. Other injuries to the extraperitoneal rectum can be managed with fecal diversion alone. Destructive rectal injuries that involve more than 50% of the rectal wall circumference may require resection of the rectum above the injury with the creation of an end colostomy.

DUODENAL TRAUMA

Duodenal injuries are uncommon after blunt trauma but are challenging to diagnose and manage. Less than 1% of patients experiencing blunt trauma sustain a duodenal injury. They are caused by a blow to the epigastrium resulting in contusion of the wall or a blowout secondary to acute rise in intraluminal pressure as in case of abdomen being struck by a steering wheel or bicycle handlebar. Chance fractures of the lumbar spine increase the likelihood of duodenal injury. The identification of duodenal injuries is challenging and requires a high index of suspicion to avoid missed injuries. Because of the retroperitoneal location of a significant portion, physical examination findings can be limited. Even full-thickness perforations of the duodenum may not demonstrate peritoneal signs unless the perforation involves an intraperitoneal segment.

Investigations

Abdominal X-ray may show retroperitoneal air or obliterated right psoas muscle margin. The mainstay of evaluation for duodenal injury is abdominal CT with luminal contrast. Findings that reflect possible duodenal injury include thickened duodenal wall, air or fluid outside the bowel lumen and contrast extravasation. Low-grade injuries resulting in duodenal hematoma can be identified by CT, although it is important also to evaluate the pancreas due to a high risk of concomitant injury. At times, the findings can be subtle but a low threshold for exploration should be maintained because of the potential for false-negative interpretations. Upper GI contrast studies, DPL, and serum amylase level determination, have a limited role in the evaluation of duodenal injuries.

AAST grading of duodenal injuries:

GRADE	INJURY TYPE	DESCRIPTION OF INJURY
I	Hematoma Laceration	Involving single part of duodenal wall Partial thickness; no perforation
II	Hematoma Laceration	Involving more than one part of duodenum <50% circumference disruption
III	Laceration	Disruption of 50 - 75% circumference of 2^{nd} part ; Disruption of 50 - 100% circumference of 1^{st}, 3^{rd} & 4^{th} parts of duodenum
IV	Laceration	Disruption of >75% circumference of 2^{nd} part; Involvement of ampulla or distal CBD
V	Laceration Vascular	Massive disruption of duodenopancreatic complex; Duodenal devascularisation

Management

Management of duodenal injuries depends on the severity and the location of injury. Any indication of duodenal perforation on examination or imaging should prompt operative exploration. Duodenal wall hematomas typically require no treatment unless they are large and result in gastric outlet obstruction. Treatment of obstructing hematomas comprises of gastric decompression and initiation of total parenteral nutrition, with re-evaluation with a contrast study after 5 to 7 days. If after 2 weeks of bowel rest the obstruction persists, exploration is warranted to evaluate for perforation, stricture or associated pancreatic injury.

Most full-thickness injuries of the duodenal wall can be repaired primarily using a single- or double-layer technique, depending on the amount of tissue left. Adequate mobilization of the duodenum with extended kocherisation is required to provide the necessary exposure and to ensure a tension-free repair. Duodenal transection can be managed by primary anastomosis as long as ampulla is not involved and the involved segment is short. Larger segments of duodenal destruction require more complex reconstruction, frequently using a bypass (Roux-en-Y duodenojejunostomy) around the injured duodenum. Any repair may be protected from enteric contents by performing a pyloric exclusion and creating a gastrojejunostomy. Irrespective of the time to diagnosis or the type of operative procedure chosen, duodenal injuries are at a high risk of leakage and must be widely drained.

In Damage control setting, the technique of tube duodenostomy or resection leaving the GI tract in discontinuity is highly effective for controlling the contamination temporarily.

GASTRIC INJURIES

Blunt gastric injuries are rare, occurring in < 0.1% of all blunt trauma patients. These injuries are associated with a significant mortality. The proposed mechanism of blunt gastric rupture is an acute elevation in intraluminal pressure from external forces resulting in bursting of the gastric wall. Associated injuries are common, as a result of high velocity impact needed for causing gastric injury, and often include injuries to the liver, spleen, pancreas, and small bowel. While outcomes for the gastric injury itself are generally good overall, mortality is frequently attributed to these associated injuries.

Clinical presentation and investigations

Gastric injuries will often be identified on physical examination by the presence of features of peritonitis. A bloody nasogastric aspirate may be observed. Some injuries can be identified by CT scan or DPL but their value is limited. Chest X-ray may reveal sub-diaphragmatic free air in <50% of cases.

AAST grading of gastric injury:

GRADE	DESCRIPTION OF INJURY
I	Contusion or hematoma Partial thickness laceration
II	Laceration <2cm in OG junction or pylorus Laceration <5cm in proximal $1/3^{rd}$ stomach Laceration <10cm in distal $2/3^{rd}$ stomach
III	Laceration >2cm in OG junction or pylorus Laceration >5cm in proximal $1/3^{rd}$ stomach Laceration >10cm in distal $2/3^{rd}$ stomach
IV	Tissue loss or devascularisation <$2/3^{rd}$ stomach
V	Tissue loss or devascularisation >$2/3^{rd}$ stomach

Management

Surgical repair of gastric injuries is based on the severity and injury location. Large intramural hematomas need to be evacuated to ensure the absence of perforation, followed by control of bleeding and closure of the seromuscular layer with nonabsorbable suture material. Full-thickness perforations must be debrided to remove nonviable gastric tissue and then closed in single or double layers. The perforation is generally closed with an absorbable suture material followed by inversion of the suture line with nonabsorbable seromuscular stitches. Because of the size and redundancy of stomach, this can also be repaired with a stapling device. Rarely, destructive injuries to the stomach involving large portions of the gastric wall require a partial or sometimes even total gastrectomy. Reconstruction options include Billroth I or II gastroenterostomy or creation of a Roux-en-Y esophagojejunostomy.

RENAL INJURY

Blunt injuries to the kidneys result from either blows or falls on the loin or crushing injury to the abdomen, typically due to a road traffic accident. Haematuria after a trivial injury should suggest the possibility of a pre-existing renal disease such as calculus, hydronephrosis or tuberculosis. The range of injuries varies from a small sub-capsular hematoma to a complete tear through the parenchyma. The kidney may also be partially or wholly torn from its vascular pedicle; or one pole may be completely detached. Closed renal injury is usually retroperitoneal. In children with little extraperitoneal fat, the peritoneum, being closely applied to the kidney, can tear along with the renal capsule, leaking blood and urine into the peritoneal cavity.

Clinical features

Blunt renal injury is associated with local pain and tenderness, sometimes with overlying soft-tissue bruising. Hematuria may not appear until few days after the injury. Profuse bleeding can cause clot colic. A clot becoming dislodged can cause sudden haematuria between the third day and the third week following trauma in a recovering patient. Abdominal distension 24–48 hours after renal injury is probably due to the resulting retroperitoneal haematoma impinging on the splanchnic nerves.

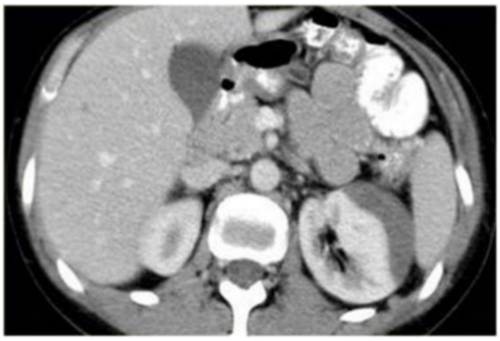
Investigations

Imaging for blunt renal injury is limited to those patients with hypotension or gross hematuria. Others who may benefit from imaging include those who have suffered significant deceleration injury, those with altered sensorium for whom physical examination is not reliable and those for whom bony injury noted on plain film assessment may suggest an increased risk of injury (e.g., transverse process spinal fractures or lower rib fractures).

While selecting patients for nonoperative management of renal injuries, contrast enhanced CT with delayed imaging is highly useful for initial patient selection and as a baseline for subsequent reassessment. It has the advantage of detailed assessment of the renal vasculature and of parenchymal damage, detection of displaced or nonperfused parenchymal fragments and urinary extravasation, and evaluation of associated non-urologic injuries.

AAST grading – Renal organ injury scale:

GRADE	TYPE	DESCRIPTION OF INJURY
I	Contusion Hematoma	Microscopic or gross hematuria Non-expanding subcapsular hematoma
II	Hematoma Laceration	Non-expanding perirenal hematoma Superficial , <1 cm depth, not involving the collecting system
III	Laceration	>1 cm depth, not extending into the collecting system or renal pelvis
IV	Laceration Vascular	Extending to renal pelvis or urine extravasation Injury to main renal vessels with contained bleed
V	Laceration Vascular	Shattered kidney Avulsion of hilum – complete devascularisation



Perirenal hematoma

Grade III renal laceration

Intravenous pyelogram (IVP) has limited usefulness in the trauma setting, but may demonstrate gross anatomic abnormalities and can indicate that the contralateral uninjured kidney is functional, which may be reassuring prior to exploring the injured kidney. When non expanding hematoma is encountered during surgery, a one-shot IVP may be obtained 10 minutes after the injection of iodinated contrast agent to exclude renovascular injury.

Management

When selecting operative versus nonoperative management for renal injuries, one should consider several variables, like, whether the patient requires laparotomy for other organ injuries, the hemodynamic stability of the patient and findings on imaging studies which play a major role in management selection. Low grade injuries (grades 1 to 3) are routinely managed non-operatively, whereas grade 5 injuries are managed with operative intervention. Grade 4 injuries may be managed conservatively in selected cases.

Non operative management

Watchful treatment of blunt renal trauma is often successful (>90%). The possibility of injuries to other organs should be considered at an early stage. Strict bed-rest is advised when there is macroscopic hematuria and activity is restricted for upto a week after the urine clears. . Urine passed should be checked for haematuria and documented. Adequate analgesia is provided. Frequent monitoring is necessary. Antibiotics should be given to prevent hematoma from getting infected.

Surgical exploration

Surgical exploration is required in less than 10 % of patients. The only absolute indications for surgery are life-threatening haemodynamic instability, renal pedicle avulsion or the finding of an expanding, pulsatile retroperitoneal hematoma at laparotomy. The aim is to stop bleeding while conserving as much renal tissue as possible. A renal arteriogram performed preoperatively may help in framing an appropriate operative strategy. Embolisation can arrest the haemorrhage if the bleeding vessel can be identified. Damage to other abdominal organs is checked during a transperitoneal approach. Release of the tamponading effect of the perirenal haematoma can result in massive haemorrhage and one must be prepared to handle such a catastrophe.

Small tears can be sutured over a hemostatic sponge or a piece of detached muscle. Large single rents in the kidney are best managed by passing a nephrostomy tube through the defect and suturing the renal tissue around it. Partial nephrectomy may be performed for localised injury. When the kidney is irretrievably ruptured or avulsed from its pedicle, nephrectomy is the only choice.

When a solitary kidney is sufficiently damaged to need exploration, it must be repaired. If it could not be repaired, the wound is packed firmly with gauze to stop bleeding with the hope that some renal function might be retained when the damaged kidney heals.

Complications

Heavy haematuria can lead to clot retention requiring frequent bladder washout. Repeat urinalysis is recommended in all cases with trauma and haematuria, irrespective of the severity, to identify persistent hematuria requiring further evaluation. Pararenal pseudohydronephrosis may occur weeks later from the combination of complete cortical tear and ureteric obstruction caused by scarring. Hypertension, not responding to drugs, as a result of renal fibrosis, may occur long after the injury. Nephrectomy may be necessary in such cases. Post-traumatic pseudoaneurysm of the renal artery is rare. There may be loin pain and a non-tender swelling may be felt if the aneurysm is large. Congestion of the parenchyma leads to intermittent hematuria. Angiography is diagnostic. Excision or nephrectomy is indicated to prevent fatal rupture of the aneurysm. Renal insufficiency may develop anytime following major injuries and may require renal replacement therapy.

BLADDER INJURIES

Injury to the bladder is identified in about 2% of blunt abdominal trauma cases, of which 80% have an associated pelvic fracture. Up to 30% will have a concomitant urethral injury. Bladder injuries can be in the form of intraperitoneal or extraperitoneal rupture. The hallmark of bladder injury is gross haematuria.

Intraperitoneal rupture

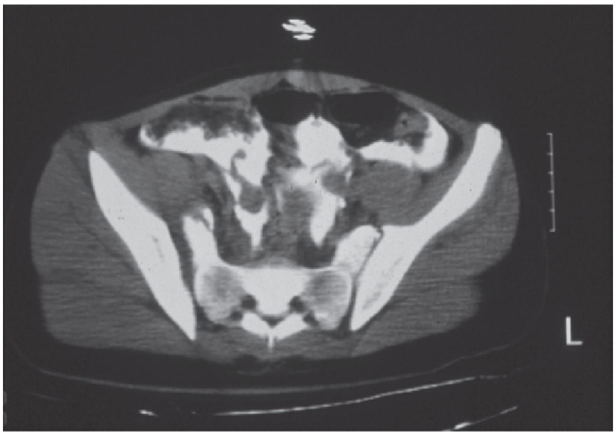
Intraperitoneal bladder rupture generally results from sudden compression of the distended bladder by impact to the lower abdomen or pelvis, resulting in a large laceration of the bladder dome as it is the weakest point. It is characterised by sudden severe pain in the hypogastrium, often associated with syncope. The shock subsides and the abdomen distends and there is absence of the desire to micturate. Peritonitis does not occur immediately if the urine is sterile and varying degrees of rigidity can be present on examination.

Investigations

. Plain erect x-ray may show a ground-glass appearance. Intravenous urography can confirm a leak. Computed tomography with cystogram is the gold standard for identifying bladder rupture. Filling of retrovesical space, paracolic gutters and outlining of intra-abdominal viscera indicate intraperitoneal rupture. Retrograde cystography can also confirm the diagnosis. It is important to image the patient after drainage of contrast as a full bladder may mask extravasation.

AAST grading of bladder injury:

GRADE	INJURY TYPE	DESCRIPTION OF INJURY
I	Hematoma Laceration	Contusion , intramural hematoma Partial thickness laceration
II	Laceration	Extra-peritoneal bladder wall laceration < 2 cm
III	Laceration	Extra-peritoneal bladder wall laceration ≥ 2 cm or intra-peritoneal bladder wall laceration < 2 cm
IV	Laceration	Intra-peritoneal bladder wall laceration ≥ 2 cm
V	Laceration	Intra- or extra-peritoneal bladder wall laceration extending into bladder neck or ureteric orifices.



CT showing features of intraperitoneal bladder rupture

Treatment of intraperitoneal rupture

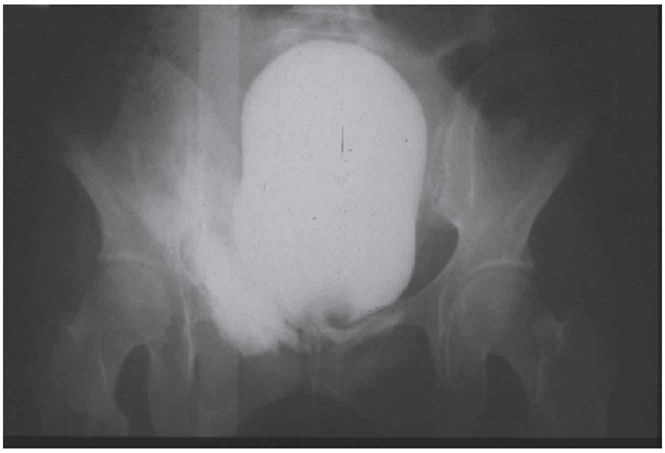
A lower midline laparotomy should be performed and the edges of the rent are trimmed and sutured with a single-layer 2/0 absorbable suture. A suprapubic and a urethral catheter are placed. Laparoscopic approaches can also be used for small rents. A follow-up stress cystogram, performed at 10 days, is usually performed prior to catheter removal.

Extraperitoneal rupture

Blunt extraperitoneal bladder rupture typically involves the lower bladder segment, usually in the anterolateral retropubic portion. These injuries usually accompany pelvic fractures. Injury is either due to a bony spicule piercing the bladder, or more commonly a tear of the bladder wall, typically on the anterolateral surface. Gross haematuria can be absent. It may be difficult to distinguish extraperitoneal bladder rupture from rupture of the membranous urethra. Clinical features include blood at the external urethral meatus and a high riding prostate on digital rectal examination. Extravasation of urine within the layers of the pelvic fascia and the retroperitoneal tissues can occur.

Investigations

Cystogram performed with water soluble contrast media is confirmatory. Findings include 'flame-shaped' areas of extravasation confined to the perivesical tissue and occasionally a ‘teardrop deformity’ caused by pelvic hematoma.



Contrast imaging showing extraperitoneal bladder rupture

Treatment of extraperitoneal rupture

Extraperitoneal rupture can be usually managed with catheter drainage alone. Operative repair may be necessary for cases in whom there is failure of catheter management (e.g., persistent hematuria with catheter occlusion). In addition, certain types of complex injuries, such as bladder neck avulsion injuries, extensive lacerations of bladder neck in women, or concomitant injury to the lower bladder segment and rectum or vagina, will require operative repair, although the definitive reconstructive procedure may be best accomplished in a second sitting. Bladder rent repair, suprapubic catheter placement and drainage of the prevesical space are performed.

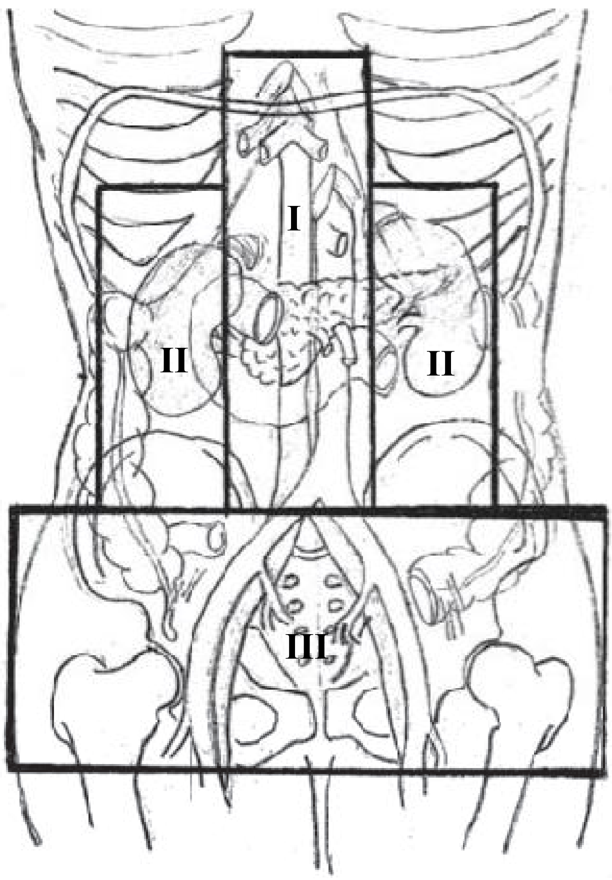
RETROPERITONEAL HEMATOMA

The great vessels of the abdomen are located within the retroperitoneum and mesenteries. Injuries to these vessels can be challenging to manage given the amount of blood loss that may be present when they are injured. These injuries frequently occur after blunt trauma. Often, retroperitoneal hematoma is secondary to a pelvic fracture as the hemorrhage from the pelvic vessels can dissect superiorly through the surrounding tissues.

After blunt trauma, injuries to the abdominal vasculature with associated hematoma are often identified by a contrast enhanced CT scan. Occasionally, it is identified during urgently performed laparotomy, although further identification of specific injury depends on the location of the hematoma. Blunt abdominal vascular injuries that are not actively bleeding may require operation to repair or may be considered for endovascular therapy.

Management

When confronted with a retroperitoneal hematoma during laparotomy, the location of the hematoma suggests the appropriate treatment.



Zone 1 hematomas, even if not expanding, require exploration because these frequently involve the aorta, proximal visceral vessels, or inferior vena cava. An exception may be the dark hematoma behind the liver, which suggests retro-hepatic vena caval injury. These injuries may be best served by not exposing the contained low-pressure injury or by gently packing the surrounding area. A hematoma in the region of zone 2 should only be explored if it appears that it is expanding. Similarly, a hematoma in zone 3 is usually secondary to bleeding from pelvic fracture and should not be explored unless exsanguinating haemorrhage is present. Prior to exploring the retroperitoneum, one should obtain proximal and distal control, both arterial and venous to prevent exsanguinating hemorrhage.

DIAPHRAGMATIC INJURY

Injuries to the diaphragm are a diagnostic challenge. They are often identified late following blunt trauma. These are believed to be a result of a rapid increase in intra-abdominal pressure during an anterior impact which causes a blowout of the diaphragmatic tissue. Injuries are most commonly recognized on the left side, with only 25% occurring adjacent to the liver or in the central tendon of the diaphragm. Diaphragmatic injuries themselves are usually of limited threat to life. They are often associated with injuries to adjacent organs.

The morbidity related to diaphragmatic injuries is sometimes identified months to years later when it was not initially recognized and repaired. The natural history of these injuries is that of progressive enlargement with herniation of abdominal viscera into thorax, which is the commonly identified abnormality on radiographic evaluation.

Diagnosis

Blunt diaphragmatic injuries are more elusive and diagnosis requires a high index of suspicion. The chest radiograph may demonstrate the presence of abdominal viscera, commonly the stomach, within the chest, although this may be absent in a significant number of patients. Passage of a nasogastric tube can be of assistance if it is identified in the lower left hemithorax and the administration of contrast can help in the detection. Chest and abdominal CT scans may demonstrate the presence of abdominal viscera in the chest or an abnormality of the diaphragm, such as discontinuity, thickening, or elevation. 3D reconstruction of the CT scan can demonstrate the defect with high sensitivity.

AAST grading of diaphragmatic injury:

GRADE	DESCRIPTION OF INJURY
I	Contusion
II	Laceration <2cm
III	Laceration 2 – 10 cm
IV	Laceration >10 cm with tissue loss <25 cm2
V	Laceration with tissue loss > 25 cm2

Management

Operative exploration may be required when imaging is suggestive. Video assisted Thoracoscopy or a cautious laparoscopy conducted to avoid tension pneumothorax is useful in patients who have no other indications for laparotomy, to visualize the diaphragm.

Repair of diaphragmatic injuries includes debridement of the nonviable tissues and closure of the defect. Diaphragm exhibits enough redundancy to close all except the largest defects primarily. Closure is usually performed with nonabsorbable suture in a single layer, incorporating large full thickness bites of healthy diaphragmatic tissue. When the repair involves mostly muscle, horizontal mattress sutures may be used to reinforce the suture line. Large areas of tissue loss are rare, and when present, may need reconstruction with a prosthetic mesh. Nonabsorbable synthetic materials are reasonable in non-contaminated fields although they must not be used when there is associated bowel injury.

OTHER ORGANS AT RISK OF INJURY

The urethra, ureters and extrahepatic biliary tree can be injured during blunt abdominal trauma. Ureteric injuries are managed based on their location by primary repair or ostomy or reimplantation procedures. Urethral injuries are managed by urinary diversion and appropriate open repair, immediately or as a delayed procedure. Late urethral strictures may require urethroplasty. Biliary tract injuries are managed by cholecystectomy, primary repair of the ducts over stents or hepato-enterostomy/choledocho-enterostomy.

MATERIALS AND METHODS

PLACE OF STUDY:

Rajiv Gandhi Government General Hospital and Madras Medical College, Chennai.

TYPE OF STUDY:

Combined prospective and retrospective study

PERIOD OF STUDY:

July 2014 to June 2015.

INCLUSION CRITERIA:

All patients admitted in RGGGH with blunt abdominal trauma in the specified time period.

EXCLUSION CRITERIA:

- Those with penetrating abdominal trauma
- Those with associated head injury, spine and limb injuries, chest injuries.
- Those not willing to participate in the study

SAMPLE SIZE:

110 cases

METHODOLOGY

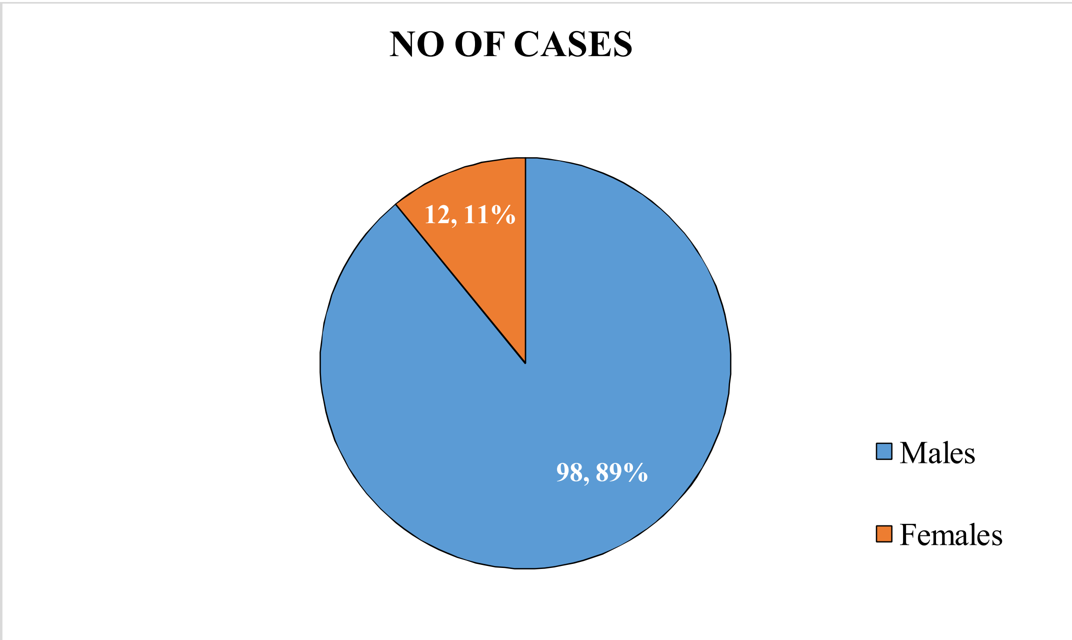
This will be a hospital based time bound study. All those cases which satisfy the inclusion criteria will be included in this study. All patients will be taken into the study after obtaining written informed consent. They will be subjected to baseline investigations (CBC, LFT, RFT, blood grouping and typing) and specific investigations namely Four quadrant aspiration, ultrasound abdomen and CT abdomen. Data will be collected in the form of detailed history, clinical examination and investigations (radiological investigations), intra operative findings and ultimate outcome of the patients.

ASSESSMENT OF PARAMETERS:

- Vitals (Pulse rate, Blood pressure, Urine output)
- Imaging and aspiration findings.
- Time from admission to surgery.
- Intraoperative findings.
- Postoperative outcome.

SEX DISTRIBUTION

- Total cases → 110
- No. of males → 98
- No. of females → 12



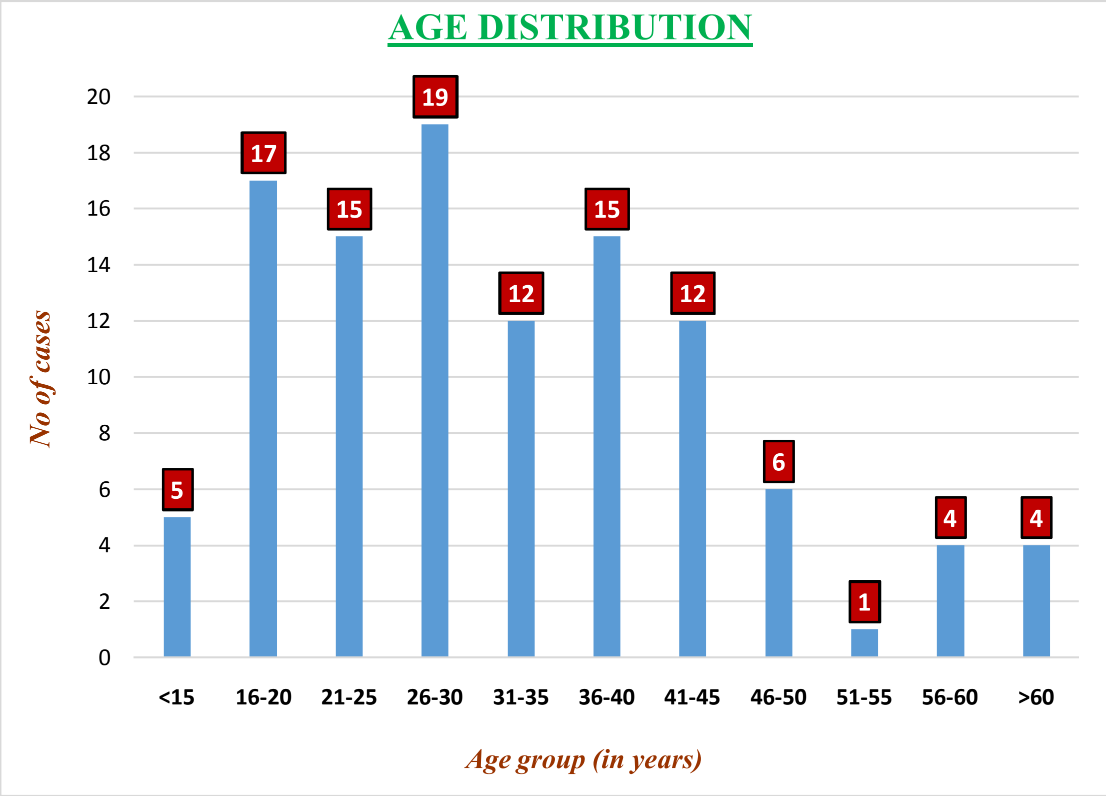
Out of the 110 cases in the study, majority (89% - 98 cases) were males and the rest (11% - 12 cases) were females.

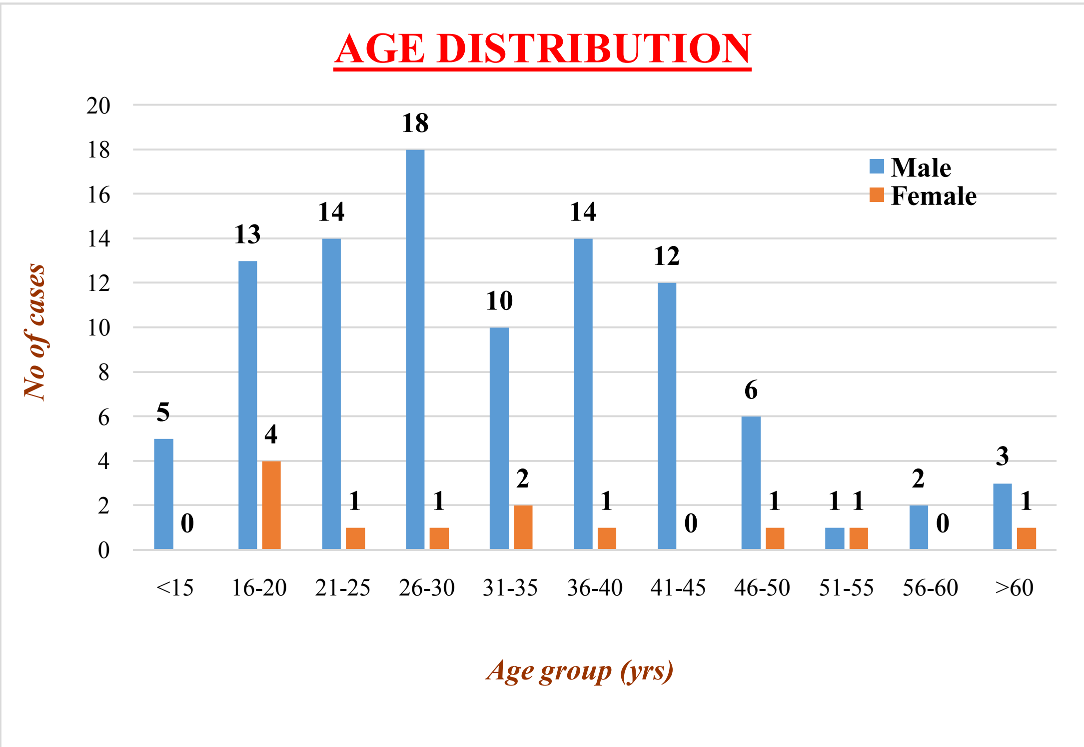
AGE DISTRIBUTION

AGE GROUP (YRS)	NO OF CASES	Males	Females
≤15	5	5	-
16-20	17	13	4
21-25	15	14	1
26-30	19	18	1
31-35	12	10	2
36-40	15	14	1
41-45	12	12	0
46-50	6	6	1
51-55	1	1	1
56-60	4	4	0
≥ 60	4	3	1

Majority of the patients belonged to adolescent, early and mid-adulthood groups with the highest being in the age group 26-30 yrs followed by 16-20 years, 21-25 yrs, 31-35 yrs age group.

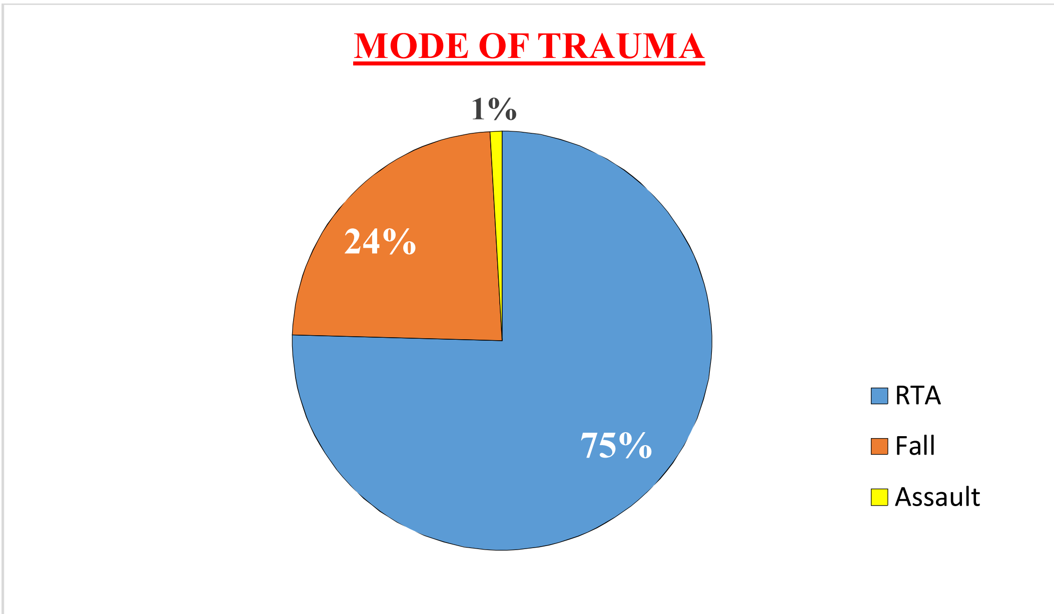
Majority of females belonged to the age group 16-20 years (33%) followed by 31-35 years (16%).


AGE DISTRIBUTION
No of cases
20
18
16
14
12
10
8
6
4
2
0
5
17
15
19
12
15
12
6
1
4
4
<15
16-20
21-25
26-30
31-35
36-40
41-45
46-50
51-55
56-60
>60
Age group (in years)


AGE DISTRIBUTION
No of cases
20
18
16
14
12
10
8
6
4
2
0
Male
Female
5
0
13
4
14
1
18
1
10
2
14
1
12
0
6
1
1 1
2
0
3
1
<15
16-20
21-25
26-30
31-35
36-40
41-45
46-50
51-55
56-60
>60
Age group (yrs)

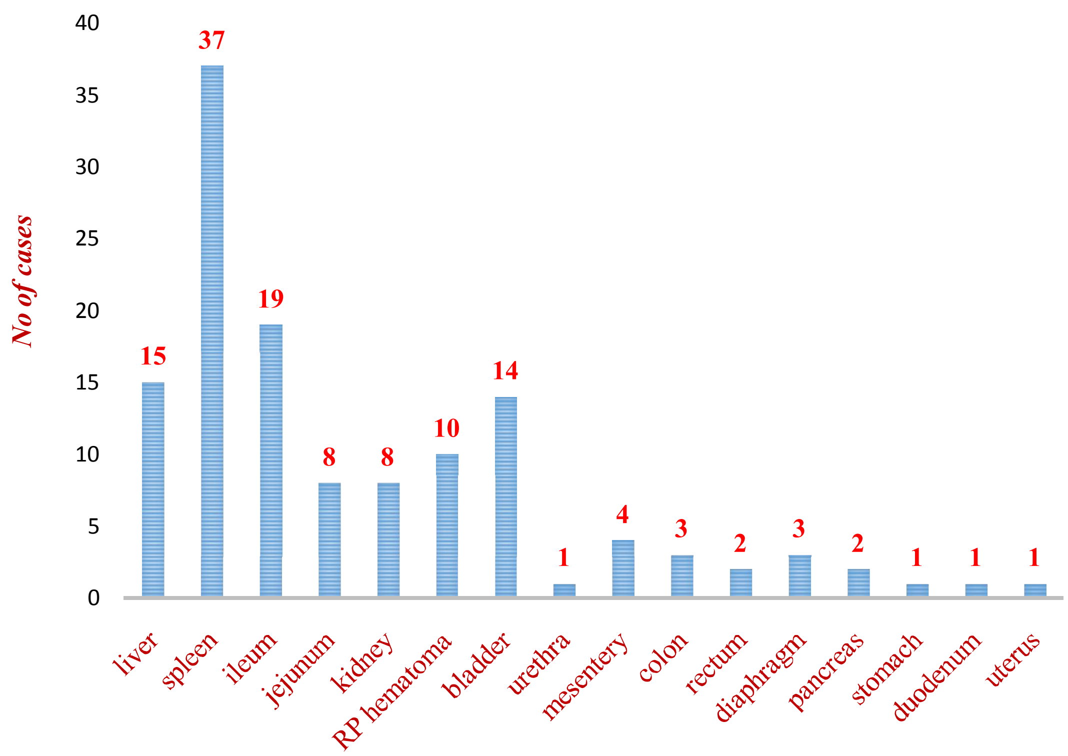
MODE OF INJURY

MODE OF TRAUMA	NO. OF CASES
RTA	83
FALL	26
ASSAULT	1



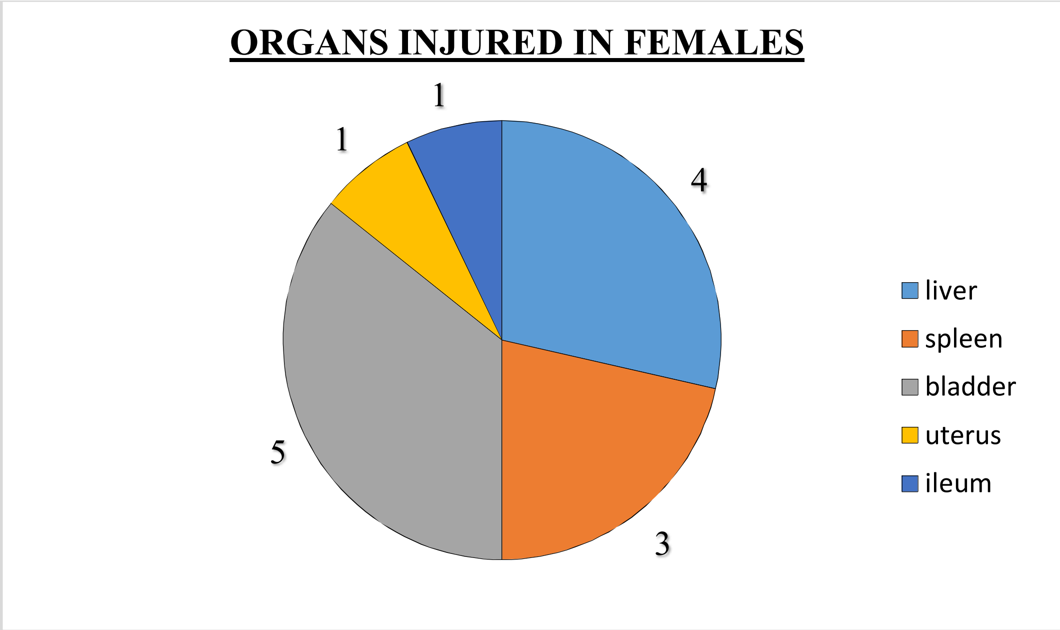
Road traffic accidents were responsible for 75% of cases of blunt abdominal trauma followed by **falls** (24%) and **assault** (1%)

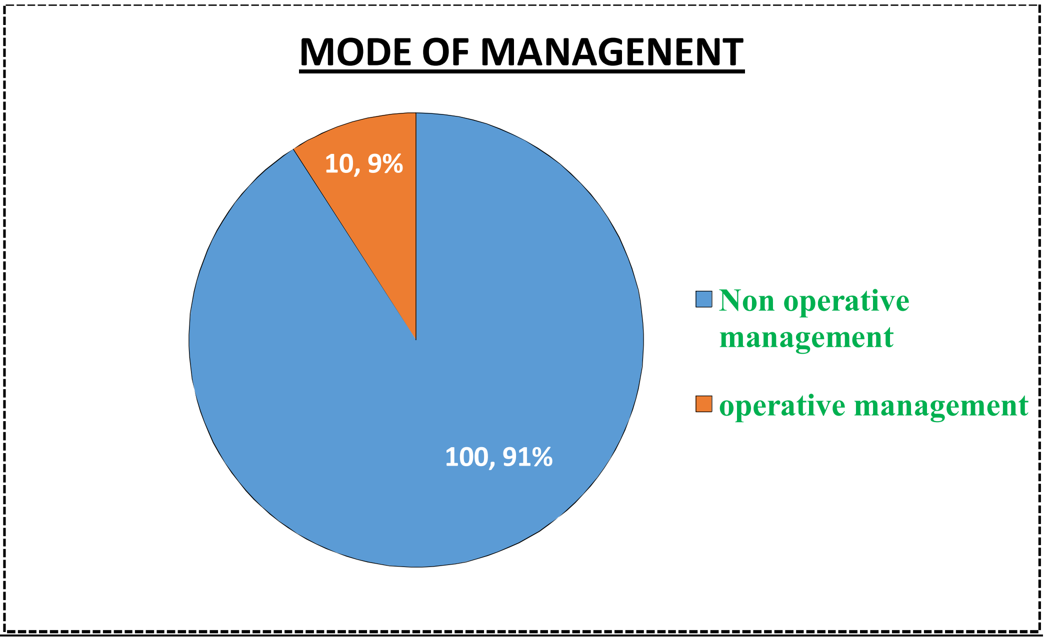
ORGANS INVOLVED



Spleen was the most common organ affected contributing to more than 33% of cases followed by small bowel (around 25%), liver (around 14%), bladder (13%) and kidney (7%). Retroperitoneal hematoma was present in 10 (9%) cases. Mesentery, colon, rectum, pancreas, stomach, diaphragm, duodenum, urethra and uterus were involved in minority of cases.

In females, bladder was the most common injured organ followed by the liver and spleen. A case of non-gravid uterine injury was recorded.

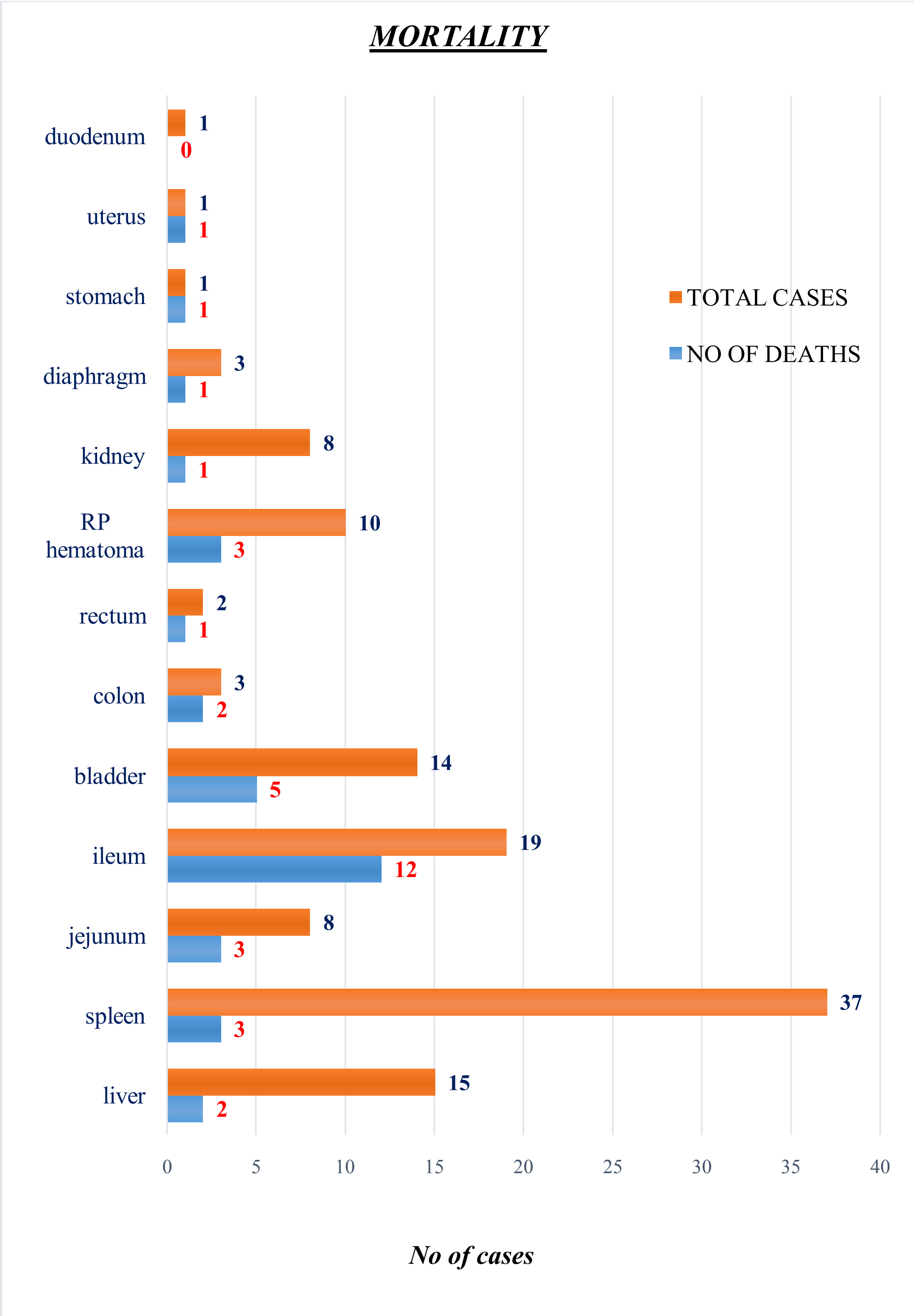


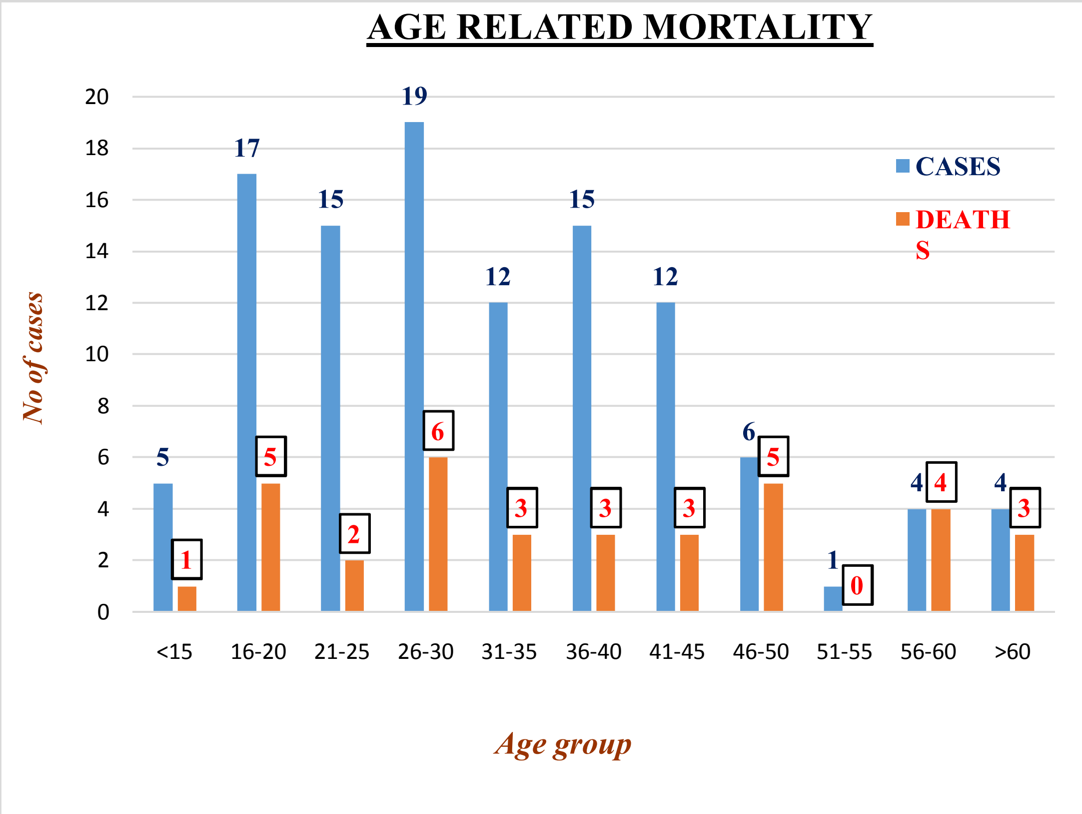


Non operative management was adopted in 9% of the cases and none needed operative intervention. The cases non-operatively managed were 4 cases of liver injury, 5 cases of renal injury, 1 case of retroperitoneal hematoma.

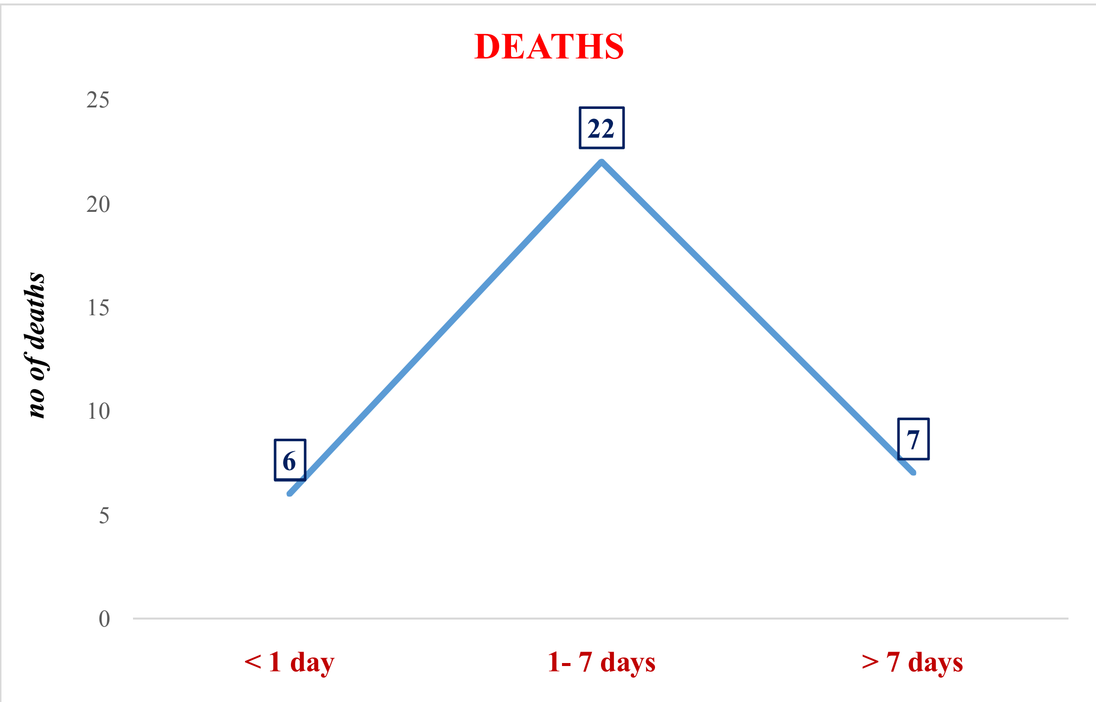
Majority of the cases (91%) were operated.

INJURY-RELATED MORTALITY

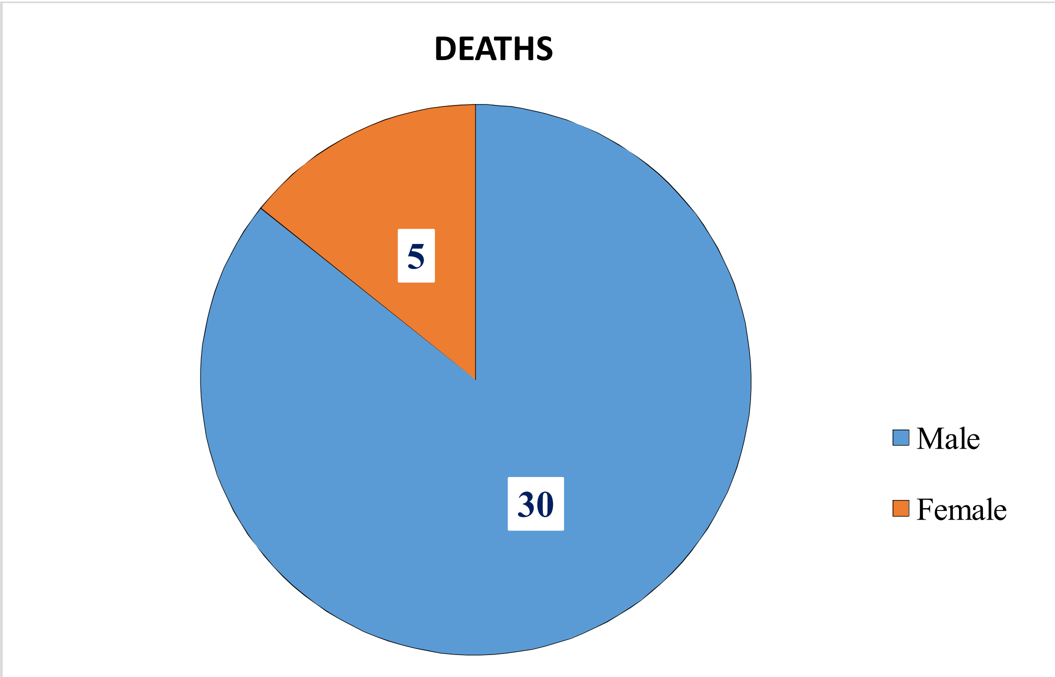




DURATION FROM INCIDENT TO DEATH



SEX DISTRIBUTION OF DEATHS

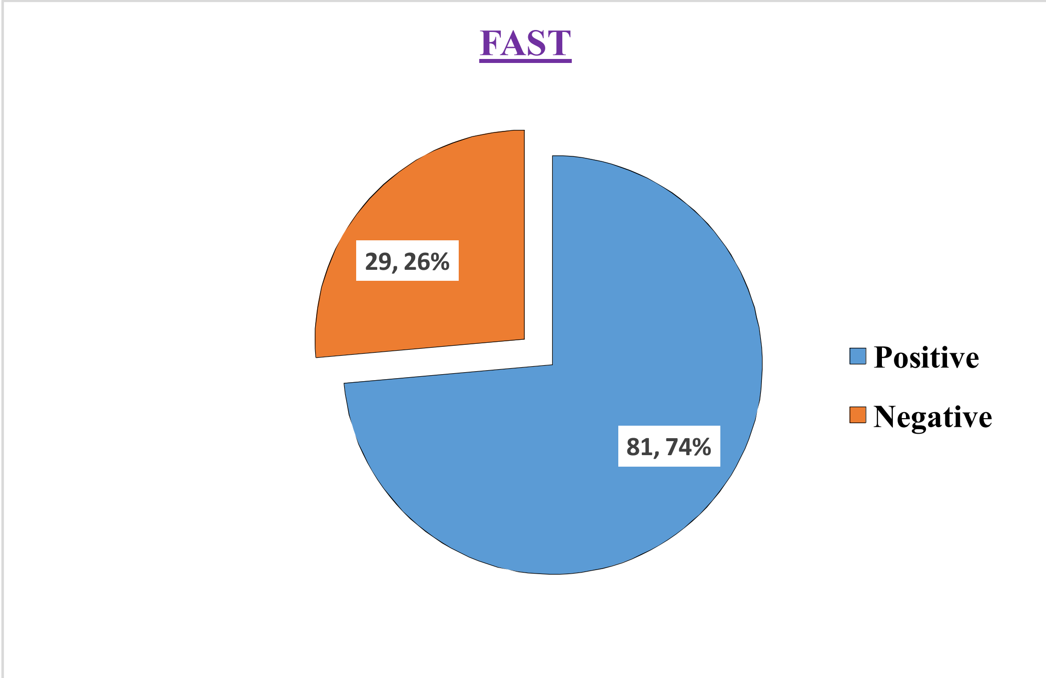


Majority of deaths occurred between the 2nd day and 7th day of the incident contributing >60% of mortality. The earliest occurred at 8 hours and the most delayed at the 18th day.

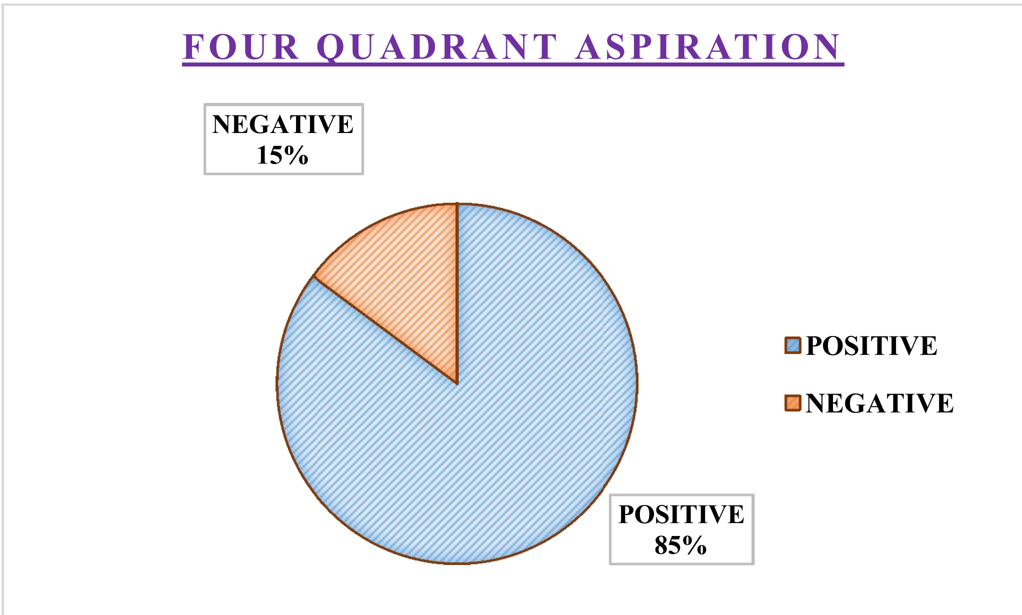
30 out of 98 males and 5 out of 12 females died as a result of complications following the injury.

Most of the deaths were due to hollow visceral perforations responsible for 19 of the 34 cases (Mortality rate > 50%) with ileal perforation contributing to the maximum number of deaths.

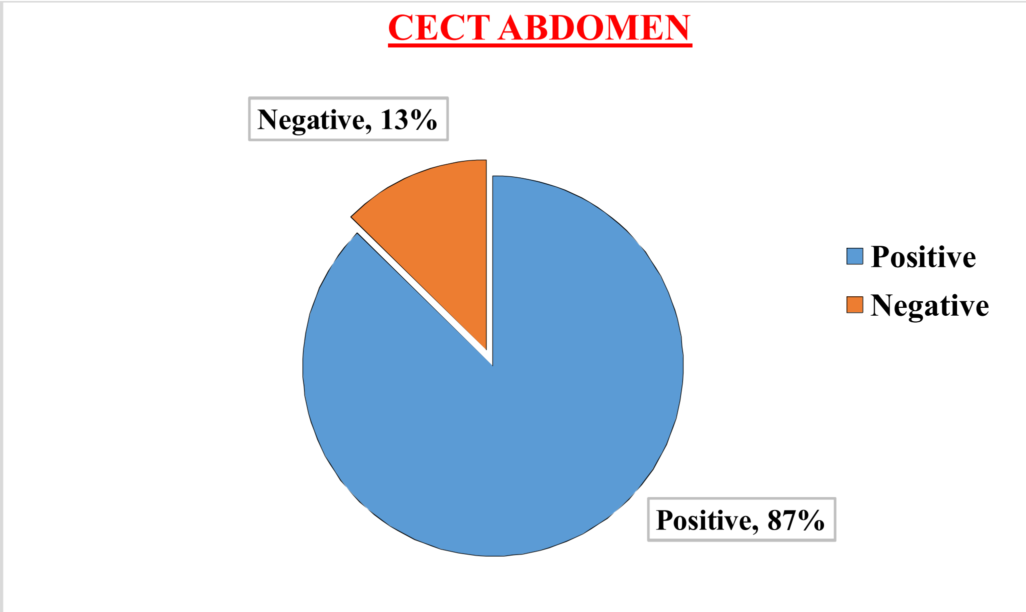
FAST → POSITIVITY RATE



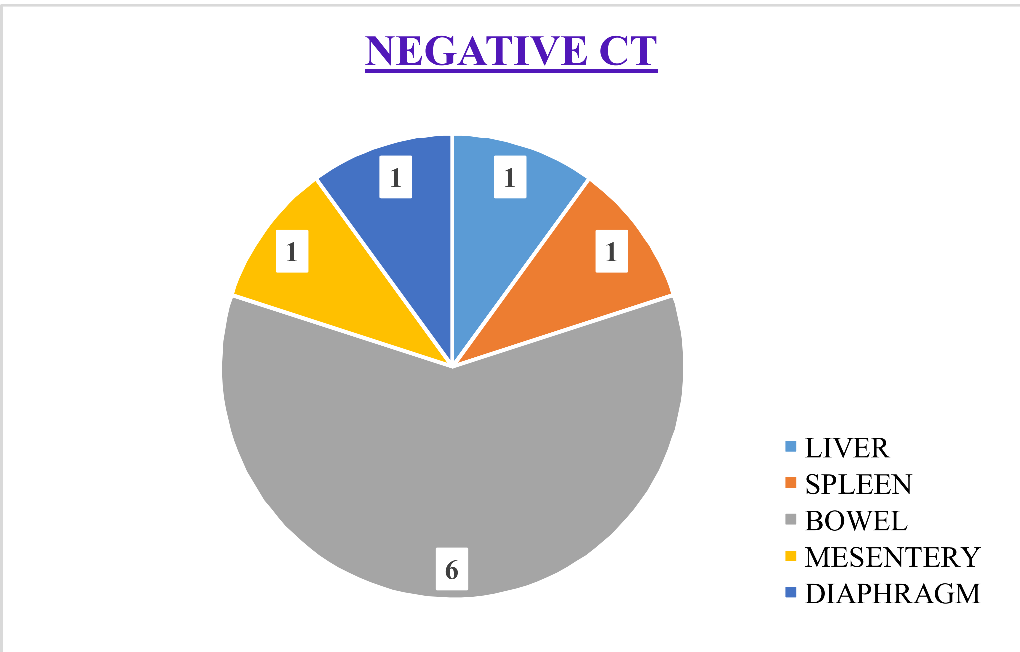
FAST was performed in all cases as the first investigation and it was found to be positive in 81 cases (74%).



All patients with positive FAST were subjected to four quadrant aspiration and it was positive in 85% of cases.



Out of 79 patients for whom CT was done, 69 patients were found to have a positive finding accounting for 87% detection rate. Small bowel injuries contributed to majority of cases with negative CT scans.



FACTORS PREDICTING MORTALITY

AGE	CASES	DEATHS	P-VALUE
< 30	56	14	0.562
30-50	45	14	0.068
>50	9	7	0.023

SHOCK	CASES	DEATHS	P- VALUE
YES	36	22	< 0.001
NO	74	13	

PERITONITIS	CASES	DEATHS	P VALUE
YES	42	20	0.054
NO	68	15	0.029

ASSOCIATED CHEST INJURY	CASES	DEATHS	P VALUE
YES	11	2	0.568
NO	99	35	0.894

INCIDENT to SURGERY INTERVAL	CASES	DEATHS	P VALUE
< 6 HRS	23	4	0.024
6-12 HRS	56	17	0.014
>12 HRS	31	14	< 0.001

SURGERY DURATION	CASES	DEATHS	P VALUE
< 2 HRS	67	12	0.050
> 2 HRS	43	23	0.034

BLOOD TRANSFUSION (units)	CASES	DEATHS	P VALUE
<2	68	16	0.165
2-4	32	13	0.053
>4	10	6	0.016

POSTOP MECH VENTILATION	CASES	DEATHS	P VALUE
YES	27	17	0.069
NO	83	18	0.025

DISCUSSION

Blunt injury abdomen is a major cause of emergency hospital admissions and surgeries. The clinical findings can be subtle. Imaging modalities help in arriving at a diagnosis and help in guiding management. The can be managed non-operatively or by trauma laparotomy. The overall mortality is around 10% which is attributable to several factors.

This combined prospective-retrospective study was conducted in Rajiv Gandhi Government General Hospital, Chennai over a period of one year to determine the epidemiology of blunt injury abdomen, the role of imaging modalities in the diagnosis and their accuracy and the various factors determining prognosis in patients with blunt trauma abdomen.

A total of 110 patients were included in the study, out of which 98 were males and 12 were females. This wide sex variation is attributable to vehicular traffic and accidents where men are predominantly involved.

Majority of the affected individuals belonged to adolescence and adulthood period with the maximum cases between 16 – 40 years of age, contributing about 55% of cases. The peak was in the age group 26 – 30 years (19 cases) followed by 16 – 20 years (17 cases). This is attributable to rash driving, driving under liquor influence and failure to use safety mechanisms like helmets, seat belts, etc.

Road traffic accidents were responsible for three quarters (75%) of the cases and the rest were due to falls (24%). Only one case due to assault was recorded during the period of study.

The most common organ injured was the spleen accounting for 34% of the cases followed by the small bowel and mesentery (28%), liver (14%), bladder and urethra (14%), kidneys (7%), large bowel (5%). Three cases of diaphragmatic injury and one case each of stomach, duodenum and pancreatic injury were recorded during the period of one year. A case of uterine injury was recorded which is very rare and only few case reports have been reported of such an occurrence. 10 patients (9%) had retroperitoneal hematomas.

All the patients were managed according to ATLS protocol and abdomen was carefully evaluated during secondary survey. Complete blood count, Renal function tests, serum amylase, blood grouping were done as necessary. CXR and Abdomen x-rays taken whenever possible.

All suspected patients were subjected to FAST examination to look for free fluid abdomen and was found to be positive in 74% of cases. The most common injuries missed were those of the hollow viscera. All patients with positive FAST were subjected to four quadrant aspiration to look for unclotted blood or intestinal contents. It was successful in 85% of those cases. DPL was not included in this study as it is not done routinely in this hospital.

Those who were hemodynamically stable (79 patients) were subjected to contrast enhanced CT scan of the abdomen and it showed a positive finding in 87% of them. The injuries that were ultimately missed on a CT were predominantly those of hollow viscera.

Majority of the patients were managed by surgical intervention. Non operative management was followed in only 9% of the cases due to the low threshold adopted for surgery in the hospital. Liver and renal injuries were those that were managed in this way. It was successful in all cases.

All hemodynamically unstable patients, those exhibiting signs of peritonitis/sepsis, those with visceral injuries as suggested on imaging and aspiration underwent laparotomy. The mean time taken from the incident to initiation of surgery was 9.9 hours; with the shortest being 2 hours and the longest being 72 hours following the incident.

Splenic injuries were detected by imaging in almost all cases and were managed by emergency open spleenectomy. The overall mortality due to splenic injury was less than 10%.

Liver injuries were identified by a high accuracy on the CT scan. They were managed by packing in majority of cases and one patient required hepatorrhaphy in addition. No active bleed was found in 2 cases and required only gelfoam application. Packing was removed on the 2nd POD in all the cases.

Small bowel injuries (jejunum & ileum) along with mesenteric injuries were those that were frequently missed by imaging. Ileum was more than twice as frequently affected as jejunum. Ileal injuries were managed either by primary repair, by resection and anastomosis or by resection and exteriorization in equal proportion based on the severity and contamination. Jejunal injuries were managed by primary repair or resection and anastomosis. The mortality rate for small bowel injuries was very high (around 60%). This was due to their late presentation and rapid onset of peritonitis and sepsis.

Colorectal injuries were diagnosed relatively late and were managed by diversion ostomy or Hartmann's procedure. The mortality rate was high (60%) due to onset of fecal peritonitis.

Urinary tract injuries were very common attributing to 20% of the cases. Bladder was most commonly affected followed by the kidneys. Bladder injury was associated with pelvic fracture and pelvic hematoma in more than half of the cases. Intraperitoneal rupture was more common. All were diagnosed using CT cystogram. They were managed by repair of the rent with suprapubic cystostomy. Renal injuries were excellently demonstrated on the CT scan. Non operative management was successful in majority (5 out of 8) of the cases. Nephrectomy was necessary in 3 cases due to grade V injury.

3 cases of diaphragmatic injuries were recorded and they were diagnosed based on the X rays. Emergency open repair was done using non-absorbable suture (prolene) material. Mesh repair was not required.

10 cases were found to have retroperitoneal hematoma involving zones II and III. Pelvic hematomas were commonly associated with bladder injuries and pelvic fracture. Only one case required exploration and ligation of the bleeding vessels in Zone III.

A case of duodenal perforation (third part) was diagnosed with CT scan and was managed by primary closure of perforation, tube duodenostomy, gastrojejunostomy, jejunojejunostomy and feeding jejunostomy. Oral water soluble contrast study done on the 10^{th} POD showed no leak.

A case of pancreatic injury was recognized on the CT scan and was managed by central pancreatectomy with pancreato-jejunostomy, gastrojejunostomy and jejunojejunostomy. The patient recovered well.

A rare case of uterine injury was recorded due to run over injury. It was associated with pelvic fracture and bladder injury. At laparotomy, the uterus was found to be transected at the internal os level and was hence managed with subtotal hysterectomy with bilateral salphingo-oopherectomy and bladder injury was repaired. The patient went in for sepsis and DIC in the post-operative period and expired on the 7^{th} POD.

The factors that were associated with increased mortality were

- Older age
- Shock at presentation
- Development of features of peritonitis
- Delay in diagnosis
- Prolonged accident – surgery time
- Prolonged surgery duration
- Per op hemodynamic instability
- Hollow visceral injuries
- Increased blood product requirement.
- Need for postoperative mechanical ventilation

CONCLUSION

- Road traffic accidents are responsible for the majority of cases of blunt abdominal trauma.
- Men are more commonly affected than women.
- Highest incidence is among adolescents and young adults.
- Spleen is the most common organ affected followed by the small bowel, liver and urinary tract.
- FAST is accurate in detection of hemoperitoneum in most solid organ injuries. Four quadrant aspiration is a useful adjunct for demonstration of free fluid.
- Contrast enhanced CT scan is the gold standard for identification and characterization of solid organ injuries.
- Majority of cases were managed by laparotomy. Non operative management was successful in all cases.
- The overall mortality rate is around 30%; most of them attributable to hollow visceral injuries.
- The factors associated with increased mortality are old age, delayed presentation, shock at presentation, associated chest injuries, delay in surgery, prolonged surgery, and need for postop mechanical ventilation.

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PATIENT PROFORMA

Name: Age: Sex:

IP No. :

DOA: DOP: DOD:

Mode of injury:

Time of injury:

Treatment/ first aid received:

CLINICAL EXAMINATION:

Airway:

Breathing:

Circulation:

GCS:

Pulse: BP:

RR: Temp:

Pallor:

CVS: RS:

P/A:

External injuries:

INVESTIGATIONS:

CBC:

Liver Function Test:

Renal Function Test:

CXR: ECG:

Blood grouping and typing:

X ray abdomen:

Four Quadrant Aspiration:

USG Abdomen:

CT Abdomen:

TREATMENT:

Intraoperative findings :

Postop period :

Condition on discharge :

S.no	Name	Age/Sex	I.P.No	Mode	FAST	FOUR QUAD TAP	CT	Time to surgery (hrs)	Injured organ	Procedure	Time to death (hrs)
1	Subramani	40/M	45024	Fall	+	+	ND (not done)	4	Spleen	Splenectomy	-
2	Muneet	25/M	43243	Fall	+	+	+	4.5	Spleen	Spleeenectomy	-
3	Sankar	42/M	45343	RTA	+	+	ND	3	Spleen	Spleeenectomy	-
4	Deepan	25/M	45751	RTA	+	+	+	16	Spleen	Spleeenectomy	-
5	Manikandan	17/M	47104	RTA	-	NA (not applicable)	-	2	Stomach	Primary closure	30
6	Raman	40/M	47534	RTA	+	+	ND	10	Spleen	Spleeenectomy	106
7	Arun kumar	28/M	51477	RTA	-	NA	+	8	Bladder	Repair + SPC	-
8	Prabhu	28/M	57551	RTA	-	NA	+	3	Colon	Sigmoid colostomy	38
9	Jayaraman	26/M	54636	RTA	-	NA	+	7	Rectum + urethra	Sigmoid colostomy + SPC	-
10	Mahesh	21/M	57300	RTA	+	-	+	6	Bladder + RPH	Repair + SPC	119
11	Manikandan	18/M	56549	RTA	+	+	ND	5.5	Spleen	Spleeenectomy	-

S.no	Name	Age/Sex	I.P.No	Mode	FAST	FOUR QUAD TAP	CT	Time to surgery (hrs)	Injured organ	Procedure	Time to death (hrs)
12	Mahesh	28/M	49997	Fall	+	+	ND	4	Spleen	Spleenectomy	-
13	Suresh	25/M	59353	RTA	+	+	ND	6	spleen	Spleenectomy	-
14	Perumal	50/M	60417	RTA	-	NA	+	18	Ileum + mesentery	Resec & anas	14
15	Dilli	78/M	61320	RTA	-	NA	-	6	ileum	Primary closure	287
16	Appukutti	35/M	63292	RTA	+	+	ND	12	spleen	Spleenectomy	-
17	Selvam	37/M	63619	RTA	-	NA	+	5	pancreas	Central pancreatectomy PJ/TD/GJ/JJ/FJ	-
18	Samanthi	47/F	65069	RTA	+	+	+	18	liver	Wash	189
19	Subramani	38/M	65729	RTA	+	+	+	6	Jejunum+ mesentery	Resection and anastomosis	-
20	Senthil	30/M	67327	fall	+	+	ND	4	spleen	Spleenectomy	-
21	Kulanthaivelu	66/M	69639	fall	-	NA	+	10	ileum	Ileostomy	111
22	Rajesh	44/M	69725	RTA	+	-	+	12	Jejunum	Resection and anastomosis	-

S.no	Name	Age/Sex	I.P.No	Mode	FAST	FOUR QUAD TAP	CT	Time to surgery (hrs)	Injured organ	Procedure	Time to death (hrs)
23	Suresh	34/M	68888	RTA	-	NA	ND	12	Diaphragm	Repair	-
24	Karthi	20/M	72231	RTA	+	+	ND	6	spleen	Spleenectomy	-
25	Duraisamy	60/M	74001	RTA	-	NA	-	4	colon	Sigmoid colostomy	93
26	Paneer	45/M	75529	RTA	+	-	+	6	ileum	Primary closure	-
27	Soundarajan	29/M	75780	RTA	+	+	+	9	liver	Gelfoam	-
28	Suresh kumar	42/M	77760	RTA	-	NA	+	8	ileum	Resection and barrel - ileostomy	122
29	Dharamchand	27/M	79233	Fall	+	+	+	12	kidney	Nephrectomy	163
30	Perumal	35/M	80537	fall	-	NA	+	-	liver	-	-
31	Manivannan	47/M	80792	RTA	-	NA	+	10	ileum	R & A	18
32	Vijayakumar	30/M	80372	RTA	+	-	+	24	jejunum	R & A	-
33	Pandiyan	31/M	81496	RTA	+	+	ND	7	spleen	Spleenectomy	-

S.no	Name	Age/Sex	I.P.No	Mode	FAST	FOUR QUAD TAP	CT	Time to surgery (hrs)	Injured organ	Procedure	Time to death (hrs)
34	Gajendran	37/M	83400	Fall	+	-	+	3	Ileum	Primary closure	-
35	Anand babu	23/M	86908	RTA	+	+	ND	5	Spleen	Spleenectomy	-
36	Kannan	21/M	88966	RTA	-	NA	+	5	Ileum, Mesentery	R & A	-
37	Angalappan	38/M	90549	RTA	+	+	+	6	R.P. Hematoma	Exploration	20
38	Sarath kumar	21/M	90816	Fall	+	+	+	12	Jejunum	Primary closure	-
39	Deepa	35/F	91639	RTA	+	+	ND	2	Spleen	Spleenectomy	-
40	Selvarasan	52/M	92032	RTA	+	+	+	-	Liver	-	-
41	Vinayagam	28/M	92512	RTA	-	NA	-	6	Ileum	R & A	120
42	Venkatraman	20/M	92634	RTA	+	+	+	15	Liver	Packing	172
43	Suresh	38/M	92949	RTA	+	+	ND	12	Spleen	Spleenectomy	-
44	Subramaniam	40/M	94395	RTA	+	+	+	-	Liver + kidney	-	-

S.no	Name	Age/Sex	I.P.No	Mode	FAST	FOUR QUAD TAP	CT	Time to surgery (hrs)	Injured organ	Procedure	Time to death (hrs)
45	Mahalakshmi	32/F	95666	RTA	+	+	+	7	Ileum	R & A	-
46	Sai	25/M	95583	RTA	-	NA	-	6	Diaphragm	Repair	-
47	Sailesh	33/M	97681	fall	+	+	+	21	Ileum	Ileostomy	10
48	Kameshwaran	8/M	98789	RTA	+	+	ND	8	Spleen	Spleenectomy	-
49	Pratap	13/M	99069	RTA	+	+	ND	2	Spleen	Spleenectomy	-
50	Vijayan	45/M	103702	RTA	-	NA	-	3	Ileum	Primary closure	-
51	Manimalar	52/F	104607	RTA	+	+	+	-	Liver	-	-
52	Meganathan	40/M	110488	Fall	+	+	-	8	Spleen	Spleenectomy	-
53	Umar	27/M	111329	fall	+	+	ND	5	Spleen	Spleenectomy	-
54	Elumalai	45/M	111841	RTA	+	+	+	12	Liver	Packing	-
55	Purushothama n	28/M	118912	RTA	-	NA	+	10	Jejunum	Primary closure	234

S.no	Name	Age/ Sex	I.P.No	Mode	FAST	Four Quad Tap	CT	Time to surgery (hrs)	Injury	Procedure	Time to death (hrs)
56	Parvathy	42/F	119924	Fall	+	+	ND	5	Spleen	Spleenectomy	-
57	Shankar	26/M	121490	RTA	+	+	+	10	Spleen	Spleenectomy	116
58	Rajesh	35/M	122125	fall	+	-	+	5	Jejunum	Primary closure	340
59	Sharath	19/M	123539	RTA	-	NA	+	72	Colon	Hartman's procedure	-
60	Kalainesan	6/M	126910	RTA	+	-	+	18	Bladder	Repair, SPC	-
61	Prabhakaran	18/M	127556	RTA	+	+	-	6	Liver	Packing	-
62	Ajith	13/M	133046	RTA	+	+	ND	3	Spleen	Spleenectomy	-
63	Desan	57/M	2217	RTA	+	+	+	6	Spleen	Spleenectomy	156
64	Chandrababu	57/M	3843	Assault	+	-	-	14	Jejunum	Primary closure	23
65	Yogesh	22/M	4669	RTA	+	+	+	-	Liver	-	-
66	Parameshwaran	56/M	4710	RTA	-	NA	+	9	Ileum	R & A	175

S. no	Name	Age/Sex	I.P.No	Mode	FAST	Four Quad Tap	CT	Time to surgery (hrs)	Injury	Procedure	Time to death (hrs)
67	Punnitavathy	18/F	4786	fall	+	-	+	-	Liver	-	-
68	Kamalakannan	45/M	13541	RTA	+	+	+	8	Bladder, RPH	Repair, SPC	36
69	Ellappan	18/M	13553	RTA	+	+	+	11	Bladder, RPH	Repair, SPC	95
70	Rajendran	50/M	13831	fall	-	NA	-	16	RPH, mesentery	Ligation of bleeding vessel	143
71	Rajamani	33/M	19940	RTA	+	+	+	20	Ileum	Closure	242
72	Surya	21/M	21741	fall	-	NA	+	10	Ileum	R & A	-
73	Sarath kumar	28/M	22226	fall	+	+	+	6	Kidney, liver, RPH	Nephrectomy, packing	-
74	Mohan	24/M	24567	RTA	-	NA	+	18	Colon	Hartman's procedure	-
75	Kanthan	37/M	24657	RTA	+	+	+	11	Ileum	Primary closure	-
76	Chandran	45/M	24843	fall	+	+	ND	8	Spleen	Splenectomy	-
77	Suresh	32/M	30315	fall	+	-	+	5	Duodenu m	Closure, TD, GJ, JJ, FJ	-

S.no	Name	Age/Sex	I.P.No	Mode	FAST	Four Quad Tap	CT	Time to surgery (hrs)	Injury	Procedure	Time to death (hrs)
78	Pandavan	50/M	31237	RTA	-	NA	ND	3	Diaphragm	Repair	43
79	Devaraj	40/M	32927	Fall	+	+	ND	5	Spleen	Spleenectomy	-
80	Ravi	25/M	36294	RTA	+	+	+	11	Bladder	Repair, SPC	-
81	Ajith kumar	19/M	36591	fall	+	+	ND	12	Spleen	Spleenectomy	-
82	Shankari	87/F	38038	RTA	+	+	+	13	Bladder, RPH	Repair, SPC	237
83	Murugan	37/M	39937	RTA	+	+	ND	6	Spleen	Spleenectomy	-
84	Rajeshwari	40/F	44427	RTA	+	+	+	11	Spleen	Spleenectomy	-
85	Kesavan	19/M	45708	RTA	+	+	+	12	Bladder	Repair, SPC	-
86	Vasanthy	30/F	46050	RTA	+	+	ND	11	Spleen	Spleenectomy	-
87	Selvam	20/M	48999	RTA	+	+	+	10	Ileum , mesentery	Ileostomy	9
88	Priya	24/M	48961	RTA	+	+	+	6	Bladder	Repair, SPC	-

S.no	Name	Age/Sex	I.P.No	Mode	FAST	Four Quad Tap	CT	Time to surgery (hrs)	Injury	Procedure	Time to death (hrs)
89	Arumugam	26/M	48832	fall	+	+	+	8	Liver	Hepatorrhaphy, packing	-
90	Annadurai	42/M	49855	RTA	-	NA	+	8	Ileum	Ileostomy	155
91	John	35/M	59105	RTA	+	+	+	-	Kidney, RPH	-	-
92	Muthumani	45/M	61005	RTA	+	+	ND	12	Spleen	Spleenectomy	-
93	Munnah	20/M	63424	RTA	+	+	+	4	Spleen	Spleenectomy	-
94	Jayaraman	65/M	65628	RTA	+	+	ND	4	Spleen	Spleenectomy	-
95	Kuppan	37/M	69854	RTA	+	+	+	-	Liver	-	-
96	Ramesh	36/M	72753	RTA	-	NA	+	5	Ileum	Ileostomy	179
97	Pandiyan	21/M	73741	RTA	-	NA	+	12	Colon	Hartman’s procedure	-
98	Akash	13/M	74881	RTA	+	-	+	5	Bladder	Repair , SPC	-
99	Prabhu	29/M	76048	Fall	+	+	ND	2	Spleen	Spleenectomy	-

S.no	Name	Age/Sex	I.P.No	Mode	FAST	Four Quad Tap	CT	Time to surgery (hrs)	Injury	Procedure	Time to death (hrs)
100	Ramya	18/F	76744	RTA	+	+	ND	16	Uterus, bladder	TAH , BSO ; repair , SPC	168
101	Patchiappan	32/M	79755	RTA	-	-	+	6	Spleen	Spleenectomy	-
102	Vinitha	16/F	79786	RTA	+	+	+	-	Liver	-	-
103	Yamuna	27/F	83676	RTA	+	+	+	6	Kidney, RPH	Evacuation	91
104	Manikandan	50/M	87412	RTA	+	+	ND	3	Spleen	Spleenectomy	-
105	Ajith kumar	17/M	86029	fall	+	+	+	24	Kidney, spleen	Nephrectomy spleenectomy	-
106	Krishna kumar	24/M	89167	RTA	+	+	ND	16	Spleen, jejunum	Splenectomy primary closure	52
107	Pradeep	27/M	91049	RTA	-	NA	+	10	Bladder, RPH	SPC	-
108	Thenmozhi	18/F	92568	RTA	+	+	+	-	Kidney, RPH	-	-
109	Jana	16/M	97838	RTA	+	-	+	8	Bladder	Repair, SPC	97
110	Ananthan	45/M	96633	RTA	-	NA	+	7	Bladder	Repair , SPC	-